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# COAST WATCH

Photo by Howard Kerby



*New techniques in bass and perch aquaculture, page 4*

Photo courtesy of Coastland Times

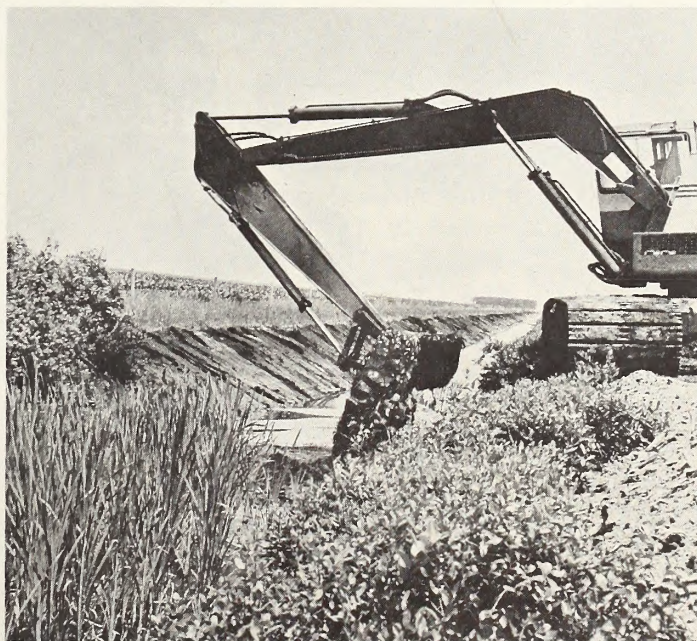


*Hurricane evacuation timing, page 6*

## Research grants For 1982

*The face of North Carolina's coast is constantly changing. Some changes are easy to accept, but others present problems with no quick remedy.*

*Each year, UNC Sea Grant identifies some of these problems and funds research designed to help solve them. In 1982, Sea Grant researchers will study several critical impacts on the estuarine system, develop new techniques in fish aquaculture, provide continuing education to local and international groups of commercial fishermen, and design methods for evacuation, should a hurricane strike.*



*Agricultural drainage impacts on estuaries, page 2*



# A unique group studies drainage impacts on estuaries

**Estuaries:** They are the nursery grounds and habitats of many valuable fish. They are the coastal mixing bowls of fresh and salt water. Wrong amounts of fresh water from upstream, and the balance is upset. And that may be the biggest problem facing the estuaries today. According to Connell Purvis, director of the state's Division of Marine Fisheries, a balanced salinity is especially critical in the primary nursery areas. "Add too much fresh water too often," he says, "and fish are either killed off or driven away. There is a direct relationship between salinity changes and the production of commercially important species."

Maintaining a stable rate of salinity, however, is not an easy task. For openers, there is very little research which quantifies salinity changes and the damaging effects that occur from accelerated freshwater runoff. There are data which indicate that the frequency and quantity of fresh water are important factors, and that the

greatest salinity changes occur in the upper reaches of the estuaries, the shallow creeks and bays. It is also known that organisms are not as abundant in areas receiving direct drainage. They are either killed during a peak runoff period, after a rainstorm, or they move to other, often less productive sites.

Agricultural and industrial developments on the Coastal Plains use ditches and canals to drain land, often directly into the estuaries. While this isn't the only method of drainage, it has been effective and cost-efficient in the past. After a rain, the suddenly increased flow of water from such drainage systems can damage estuarine life.

There may be alternative methods for drainage. If so, then we need to determine their effects on salinity and estuarine production, and devise ways for land users to work in harmony with the estuaries. This year, Sea Grant is funding a project that will study these ways and seek the best solution for the

salinity problem. B. J. Copeland, director of Sea Grant, says, "If we are going to solve this drainage problem as it relates to estuarine productivity, we are going to have to develop innovative ways to deal with drainage. There needs to be a balance of fresh and salt water to maintain the productivity of those animals we are interested in eating. The quality of the product is definitely related to the stability of the estuarine system."

To cover the broad spectrum of the issue, a team of researchers representing several disciplines is involved. Each researcher will focus his work on Rose Bay, which is considered one of the most productive areas for fishery products in the Pamlico Sound system. In addition, there are already baseline data available on Rose Bay, and this area is also being affected by existing drainage canals. The following researchers are on this project:

—Providing information on current agricultural practices are two North Carolina State University (NCSU) researchers: Wayne Skaggs from the Department of Biological and Agricultural Engineering and Wendell Gilliam from Soil Science. Jimmy Gregory of NCSU's Department of Forestry will be adding data on forestry practices. In previous work on the Coastal Plains, Skaggs developed a numerical model which simulates certain drainage methods combined with long-term weather data. This model will be tailored to the Rose Bay area to determine what effect drainage alternatives have upon fluctuations of freshwater runoff.

—Len Pietrafesa of NCSU's Marine, Earth and Atmospheric Sciences Department is developing a physical model of Rose Bay. By monitoring the area before, during and after storms, he is going to define the physical functions which determine salinity changes during runoff and create his model with this data.

—A biological model of the area is being developed by John Miller and Jim Reed of the Zoology Department of NCSU. Miller and Reed are studying the effects of salinity changes on the production of juvenile shrimp, spot and croaker. Rose Bay provides the nursery grounds for these commercially important species. Field experi-

*Photo by Ralph Mills*



*Wayne Skaggs checks equipment which records water table fluctuations*



ments will also be conducted to monitor the effects of salinity functions on growth rates.

—Ken Reckhow from Duke University's School of Forestry and Environmental Studies will combine the research models into an overall model for the project.

Project manager Dave Adams says the drainage problem is complex, but a start must be made towards a solution. Adams, visiting associate professor with NCSU's Department of Forestry and University Studies, says that the study's "tangible product will be a report evaluating its progress toward a predictive model that could be used for resource decisions." The intangible product, Adams explains, is the start of a program and the training of a group of scientists which can begin to address similar environmental problems in the state.

Photo by Mike Dunn



Zoology graduate students sample the Rose Bay estuary

## Testing blue-green algae from bloom to decay

The Neuse River, one of North Carolina's most valuable river-estuarine systems, is in danger. Like the Chowan and Pamlico rivers, the Neuse is highly valued for its commercial and sports fisheries as well as its recreational areas. But, like the Chowan and Pamlico, its value may be threatened by nuisance algal blooms.

In recent years, an increase in development along the river has brought an increase in nutrients entering the river system. Phosphate, nitrate, ammonium and other nutrients come from such sources as fertilizers, wastewater treatment plants and industries. During July and August, high temperatures and plenty of sunshine combine with the nutrients to produce broad, paint-like scums of blue-green algae. The particular algae found on the Neuse is *Microcystis*. Side effects of these algal blooms, such as toxicity, odor, fish kills and appearance, seriously threaten use of the river for fishing, boating, drinking water and agricultural and industrial purposes. An additional threat is the possible proliferation of the blue-green algae into the estuarine and marine environment.

To date, there has been very little research on *Microcystis* in the estuary and no research in North

Carolina. This year Sea Grant is funding two projects that will examine the bloom potential under varying saline conditions. They will also determine the effect of the bloom in the estuarine system.

Hans Paerl, assistant professor in the University of North Carolina at Chapel Hill's (UNC-CH) Institute of Marine Sciences, believes that salinity may be an important barrier to the proliferation of blue-green algal blooms. "The nuisance blooms detected thus far," he says, "are of freshwater origin. Little is known about their tolerance and hence potential ability to survive and proliferate in the marine environment."

In his study, Paerl will be combining field work with laboratory experiments on *Microcystis*. Samples taken during bloom and non-bloom periods will be used to identify specific nutrients and their ratios. Additional samples will be tested for salinity tolerance to determine if this species could spread into saltwater systems and survive.

In a companion project, Donald Stanley and Robert Christian, associate professors from East Carolina University's (ECU) Department of Biology, will focus on the direct and indirect effects of the bloom on the estuaries downriver. Their goal

is to determine if blue-green algal blooms could be serious enough to affect estuarine fisheries resources.

Stanley and Christian will be trying to determine in the first part of their project why the blooms don't penetrate the more saline portions of the estuary. Samples will be collected from stations along the river ranging from freshwater areas to areas with salinities of 15 parts per thousand.

In the second part of their project, they will be studying the effects of the dying, or senescent, bloom. Stanley says the senescent bloom may be even more damaging than the active bloom. Decay of a bloom may decrease oxygen supplies significantly, may create high densities of harmful bacteria or perhaps even worse, may be converted into other undesirable algal forms, a process called recycling.

"We are basically going to try to measure the death rate of the algae," Stanley says. "When these algae die and decay, nitrogen and phosphorus are given off. Through chemical techniques, we are going to measure how fast the nitrogen and phosphorus are recycled and the rate of conversion of this algal nitrogen back into another algal form."

*Continued on next page*



The results of Paerl, Stanley and Christian's research will provide much needed information on *Microcystis* growth and harmful effects in the Neuse estuary. Data obtained in the study will be useful to state agencies interested in not only the control or eradication of the bloom, but also what effects it has on fisheries in the Neuse River estuary.

Photo by Hans Paerl



*Blue-green algae found on the Neuse River near New Bern*

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## A study in Teamwork

In the past few years, residents along the White Oak River have noticed several changes in the river. Recreational boaters complained of shallower waters and of some areas which had become barely navigable. Commercial fishermen reported that their catches of fish and shellfish were getting smaller. Agreeing that something had to be done to "save their river", they formed the White Oak River Advisory Council.

According to council members, sedimentation is the problem here. Over the years, sediment, such as sand and silt, has been building up at the mouth of the river and causing the channel to become narrower and shallower. Sedimentation was also blamed for the river flowing more slowly than normal. Charles Daly, a spokesman for the council, says past studies have indicated that this buildup of sand and silt on the White Oak was caused by the dredging of the Intracoastal Waterway by the U.S. Army Corps of Engineers and the construction of a causeway, N.C. 24, at Swansboro. The council took their concerns to the governor in an appeal for funds to study the problem.

Last fall, \$50,000 was appropriated by the General Assembly. A unique study team, involving state and federal agencies, universities, private consulting firms and local citizens, was formed. This year, Sea Grant will also be lending support to the White Oak River project. Working together on the team are representatives from the council, NCSU, the University of North Carolina at Chapel Hill and Wilmington, ECU, Water Resources Research Institute, Sea Grant, the Department of Transportation's Divi-

sion of Highways and the Department of Natural Resources and Community Development's Office of Water Resources, Office of Coastal Management, Division of Marine Fisheries and Division of Environmental Management. A report on the team's research will be presented to the legislature this summer.

According to B. J. Copeland, director of Sea Grant, an important outcome of the study will be the example

of government agencies working with universities and local citizens. "I think we're on to something good here," Copeland says, "working together as a team, we can put science applications to work on the council's problem, and their involvement is essential in this study. I think this is a very effective way of providing the council and the state with the information needed to solve this problem."

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## Raising fry and fingerlings

In the last 10 years, Atlantic Coast populations of striped bass have been declining rapidly. At the same time, commercial fishing pressure had increased. To replenish stocks of this very desirable food and sport fish, researchers have tried stocking larvae in lakes and reservoirs. But survival rates of the wild-stock larvae have been very low. However, much higher survival rates have been recorded with some striped bass hybrids.

Two Sea Grant researchers, Howard Kerby and Mel Huish of the zoology department at NCSU, have been successful in the past few years raising striped bass X white bass hybrids. Working at the NCSU Aquaculture Demonstration Project at Aurora, they have raised fish from fingerlings stocked in ponds, cages and large cir-

cular pools. Survival rates have normally exceeded 90 percent.

"Hybrids," Kerby says, "grow faster, are heavier and have a deeper body. A hybrid the same length as a striped bass will weigh more because of its deeper body. Hybrids are also hardier," he adds, "which makes them easier to handle and work with under culture conditions."

This year, Kerby and Huish, assisted by graduate student Curry Woods, will focus their research on production of striped bass hybrids during the first eight months of life—from fertilized eggs to fingerlings. In one phase of this project, hybrid fry will be cultured to a larval stage in 10,000-gallon circular pools. In a second phase, hybrid larvae will be stocked in quarter-acre ponds for grow-out to the fingerling stage.



Both fresh and estuarine water will be tested in the pools and ponds. A third phase will compare growth and survival rates of the pond-raised fingerlings in the fresh and estuarine water.

Ron Hodson, Sea Grant's associate director and project director of the Aquaculture Demonstration Project, says research efforts with hybrids are just beginning. "We know we can grow marketable hybrids in sixteen to eighteen months. With research, we can probably shorten this time. A lot depends on getting the larvae off to a good start and providing them with optimal growing conditions through the whole process."

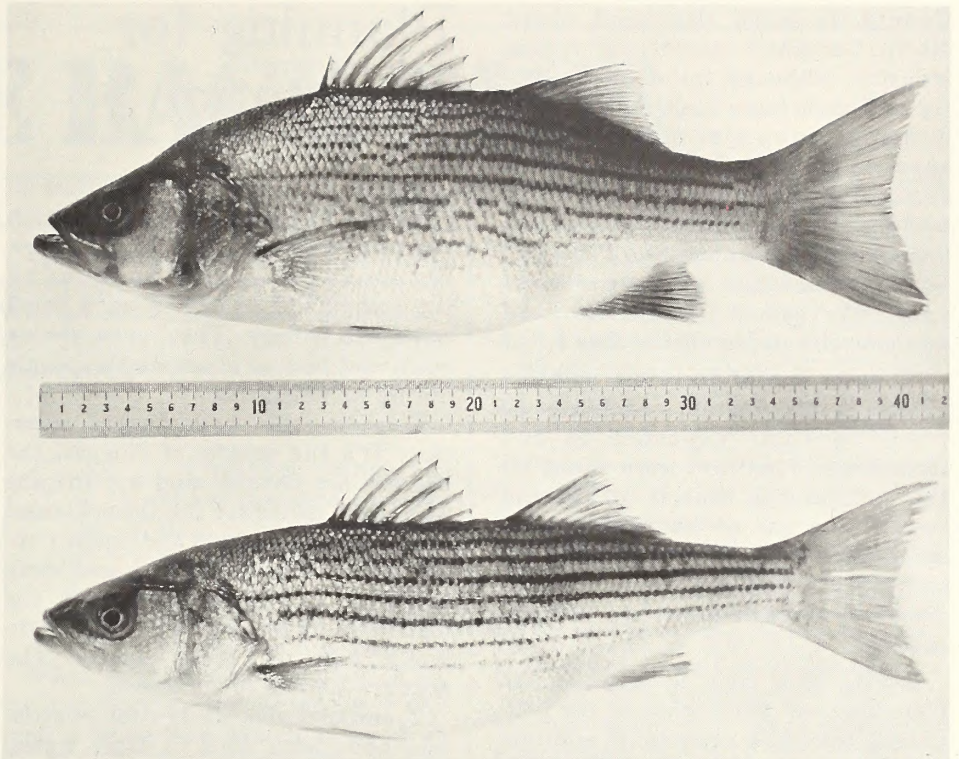
The techniques developed in this project will not only benefit other agencies working with hybrids, but it could be the start of a new aquaculture industry in North Carolina, Kerby says. "Hybrids," he adds, "could be the alternative market fish for the declining striped bass."

Another popular food fish is the yellow perch. In the Midwest, demand for this species far exceeds supply even though great numbers are harvested in the Great Lakes. Aquaculture projects in Wisconsin have been raising yellow perch, but their efforts have been hampered by a short growing season and the lack of a dependable supply of fingerlings.

Coastal North Carolina is on the southernmost range for this species and has the optimum temperatures necessary for a long growing season. But, yellow perch is not commercially fished in this state. Because of the low demand and available supplies, the catch is incidental.

Jeff Hinshaw, a NCSU graduate student working with Kerby and Huish, thinks the yellow perch has much greater potential in North Carolina. This year, he will be using the Aquaculture Demonstration Project's facilities to produce fingerlings from larvae and to produce a dependable supply acclimated to culture conditions.

"One of the potential benefits from this work," Hinshaw says, "will be an exchange program with fish farmers in the Midwest." In North Carolina, the spawning season for yellow perch is one to four months ahead of the Midwest season. Hinshaw hopes to set up a cooperative program with Midwestern fish farmers to ship eggs and larvae to them during their off-



*A striped bass hybrid (top) the same length as a striped bass (bottom) generally weighs more because of its deeper body*

season in return for the same during the off-season here, extending the growing season for both regions.

Research on yellow perch also increases the potential for grow-out in North Carolina or other southeastern states. Climate and the longer growing

season give North Carolina an advantage over growers in the Midwest, according to Hinshaw. "We can produce more fish per given unit of time," he says. "There is already a market for this highly valued species, and that's the main criterion for aquaculture."

## Transferring technology and skills

Commercial fishing, like most businesses, has gotten more complex over the years with advances in technology. Fishermen today have to keep abreast of the latest in equipment, and know how to use it in the most cost-efficient way. In many small, family-owned operations, which are characteristic of most of the industry in North Carolina, a fisherman may wear a number of hats: bookkeeper, net mender, welder, mechanic, navigator and seafood processor in addition to boat captain.

In 1981, over 250 fishermen learned about the latest developments in technology and improved their technical skills in a program coordinated by Jim McGee of the Division of Continuing Education at ECU. Funded by Sea Grant, this program will be expanded

and offered again in 1982.

Designed for both the seasoned fisherman and the novice, the curriculum will begin with an emphasis on business affairs, from financing the boat to paying taxes. "We will be covering a variety of topics," McGee says, "from fuel economy and boat building to navigation and cold water survival. The program will include workshops, lectures, demonstrations and individual instruction."

This year, a special international section has been added to the program. Sea Grant's director, B. J. Copeland, calls the international program a "transfer of technology with very positive benefits for both countries." Forty Nigerians are coming to Dare

*Continued on next page*



County to learn first-hand about North Carolina's commercial fishing industry. Although the African country of Nigeria has a healthy seafood industry of its own with an abundance of resources, McGee says it is technologically undeveloped by modern standards. Most of the actual fishing and processing work is done with manual labor. (At least 45 percent of this work is handled mechanically in North Carolina.)

"I guess one of the most valuable aspects of this program," McGee says, "will be their exposure to our technology. They will learn about all the mechanical aspects of fishing vessels, the use of electronic equipment, processing of marine products and much greater utilization of their resources through importing and exporting."

During their training program, the Nigerians will participate in the continuing education program in addition to attending extension classes through a local technical college, College of the Albemarle. Trainees interested in a particular skill, such as net making, will also be required to work in an apprenticeship program.

But, the learning process isn't going to be one-sided. McGee anticipates that local fishermen are also going to learn more about the industry, especially on an international level. He hopes that if this program proves successful, it can be used as a model for future involvement in international cooperative ventures.

## Planning for Evacuation

The threat of a hurricane is a fear all coastal residents and visitors face each year as the season begins in June. But, perhaps an even greater fear is felt by the community leaders of each small town and village. They must decide when and how to evacuate the people during an emergency.

Consider this hypothetical situation: It's the middle of August, the beaches are packed, and a hurricane warning is issued for the Outer Banks. Over 100,000 residents and tourists are asked to evacuate the area, and there are only two roads leading to the mainland. How long will it take to safely evacuate these people? The answer—no one really knows.

Transportation studies for evacuation have been done in other states, such as Texas and Florida. In the Galveston and Tampa Bay regions, highly computerized models have been developed to evacuate these large, urban areas should disaster strike. But, these same models can't be applied to North Carolina's coastal communities, which are predominantly small and rural. "That's the wrinkle in my study," says John Stone, assistant professor of civil engineering at NCSU.

In a new Sea Grant project, Stone will be assessing the transportation problem of North Carolina's coast to estimate evacuation time. He says a

typical transportation problem for evacuation includes consideration of the following factors: the population and its density; coastal topography; the transportation system and the number of alternate routes; and the storm and its location, intensity, speed and direction of travel.

"Given this type of information," Stone says, "we can basically determine how many vehicles that roadway can carry in an hour." John Sanders, Sea Grant's coastal weather awareness specialist, will be providing Stone with the necessary transportation, topography, storm and population data for two sample areas: Route 130 at Holden Beach and Route 33 in the Lowland-Hobucken area. Stone says the results of this limited study will be a set of simplified techniques designed for small communities.

An example of one manual technique could be used to answer the question asked in the beginning of this article. According to Sanders, the National Hurricane Center estimates that in time of disaster 600 vehicles using a single lane of highway could travel 30 miles in one hour. In each vehicle, there would be approximately 2.5 people. Therefore, to evacuate 100,000 people in an area, it would take approximately 67 hours. The only trouble with this figure is that a warning means a hurricane may strike in 24 hours. While this general formula may not be accurate for the Outer Banks area, it does emphasize the great need for a system coastal communities can use to estimate evacuation.

*Photo courtesy of Coastland Times*



*Flooding is a common transportation problem which slows down hurricane evacuation traffic*



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



If commercial fishing is your business, mark your calendar to attend the Workboat Expo in Morehead City on March 13 and 14. Sponsored by Sea Grant, the show will feature exhibits by dealers and manufacturers of workboats, fishing nets and gear, radios and electronic equipment and accessories for commercial fishermen. A series of mini-seminars open to the public will also be held during the show. Topics will include financing your boat, sail power as an alternative, net mending, fiberglass repair and maintenance, marine insurance, diesel maintenance and peeler crab operations.

The Workboat Show has been organized by Sea Grant marine advisory services agents Bob Hines and Larry Giardina in Bogue Banks, Jim Bahen in Wilmington and Hughes Tillet in Manteo. The location for the show is the Morehead City National Guard Armory at 3609 Bridges Street. Hours are 10:00 a.m. to 5:00 p.m. on Saturday, March 13 and 11:00 a.m. to 5:00 p.m. on Sunday, March 14. Admission is free for the show and all seminars.

The North Carolina Marine Resources Center at Fort Fisher has a new director. James A. Lanier, who joined the staff February 1, comes to the Center from Princeton, New Jersey, where he was director of education programs for the New Jersey Marine Sciences Consortium. He has also been director of education at the Virginia Institute of Marine Sciences.

Lanier received his masters and doctorate degrees in marine science from William and Mary. He is president of the National Marine Education Association.



Question: Where in North Carolina can you find mountains next to the coast and wildlife right around the corner? Answer: At the Outdoors North Carolina Expo.

Billed as "the largest exposition on the outdoors in the Southeast," the expo is being held March 25 to 28 at the Raleigh Civic Center. The state's Department of Natural Resources and Community Development (NRCD) is coordinating the event which will include exhibits and displays from 11 public-interest groups, the Museum of Natural History and the state departments of Administration, Commerce, Cultural Resources, NRCD and Transportation. There will also be exhibits from commercial manufacturers of outdoor sporting equipment.

The theme of the expo is to promote outdoor recreation in North Carolina, as well as an appreciation of the state's natural resources.



Divers and underwater photographers from across the country will gather in Raleigh March 12 for a three-day salute to life under water.

The occasion is SEAS '82, the second annual Southeast Atlantic States Underwater Conference and Film Festival. For the second year, UNC Sea Grant will help sponsor the conference, which will include workshops, films, exhibits and lectures by some of the nation's top divers and photographers. Among the speakers will be Stan Waterman, who will conduct workshops on underwater photography, and Sir Robert Marx, whose workshops will cover wreck div-

ing and underwater archaeology. Other workshops will include such topics as treasure diving, accidents, sharks and marine geology.

SEAS '82 will kick off Friday evening, March 12, with a social, and continue through the weekend, with activities at two Raleigh hotels and a film festival at Raleigh's Enloe High School Auditorium.

If you're interested in attending SEAS '82, register now. For a registration form and more information, write: SEAS '82, P. O. Box 31186, Raleigh, N.C. 27622, or call (919) 781-6330.

SEAS '82 is sponsored by the N.C. Marine Education and Resources Foundation, the N.C. Wreck Divers Association, the N.C. Office of Marine Affairs and UNC Sea Grant.



State officials and coastal scientists are coming to Elizabeth City, March 3, for a "Conference on the Albemarle Sound—Trends and Management Needs." Area citizens, legislators, state officials and scientists are concerned about the water quality of the Albemarle Sound and its tributaries such as the Chowan and Roanoke Rivers. Already a legislative committee has been appointed to study the problems of water quality in northeastern North Carolina and report to the 1983 General Assembly with its recommendations.

Now the legislative committee, along with representatives from 12 northeastern counties and others, are being invited to attend the March conference, which will be sponsored by UNC Sea Grant, the Water Resources Research Institute and other state agencies. The featured speaker for the conference will be David Stick, historian, who will speak on historical trends of the Albemarle Sound. Other speakers will include UNC Sea Grant Director B.J. Copeland, Jay Langfelder, assistant secretary of

*Continued on next page*



Natural Resources and Community Development and Connell Purvis, director of the state Division of Marine Fisheries. The purpose of this conference will be to inform those who attend about the physical, historical and biological characteristics of the Albemarle Sound and how it responds to environmental and man-made changes.



Yes, Virginia, Christmas trees are still important after the holidays are over. This year, hundreds of trees were given a new purpose in the second annual dune-repair and Christmas-tree-recycling program.

Spencer Rogers, Sea Grant's coastal engineering specialist, set up the program with the North Carolina Marine Resources Center at Fort Fisher and several local organizations. In the past two years, Rogers says several hundred volunteers have braved cold and nasty weather to set out over 600 trees. Trees stripped of decorations are placed in worn areas along the dunes where they trap and hold sand in their branches.

Participants in this year's program met on January 3 at the center. After a 15-minute talk by Rogers on repairing dunes, the volunteers took a field trip to the beach to deposit the trees.



Lundie Mauldin, Sea Grant's marine education specialist, again has organized a series of summer workshops for North Carolina teachers.

The first workshop has a tropical setting—Andros, Bahamas. UNC Sea Grant and the N.C. State Museum of Natural History are sponsoring this tropical workshop set for June 27 to July 3. To be eligible, a teacher must be scheduled to teach science in 1982-83. The approximate cost of the trip is \$450. To reserve a spot for the Andros workshop, a \$100 deposit must be received by April 15 along with an application form. Space is limited to 20 teachers. For applications and further information, write Lundie Mauldin, 105 1911 Building, North Carolina State University, Raleigh, N.C. 27650 or call (919) 737-2454. Or, contact the museum at (919) 733-7450.

In another cooperative project with the Museum of Natural History, Mauldin has organized a series of three workshops called "Cross Carolina." In these workshops, teachers will examine the mountain, piedmont and coastal habitats and learn how to plan and execute field trips. The mountain workshop will be held July 5-9 in Boone; the piedmont workshop, July 19-23 in Raleigh; the coastal workshop, July 26-30 in Nags Head. Elementary or secondary science

teachers may attend one or all three workshops. Tuition for each workshop is \$110. This cost covers housing only. Each of the workshops offers 3½ hours course credit through the NCSU Department of Continuing Education. For an application, write or call Mauldin. Space is limited.

Finally, Mauldin is offering a workshop for 15 to 25 teachers at the N.C. Marine Resources Center at Bogue Banks, July 11-17. Called "The Sea and its Harvest", this workshop is designed for vocational instructors teaching home economics, pre-vocational career exploration and marine occupations. Teachers will learn about the harvesting, processing and preparation of seafood. Tuition for the workshop is \$100. Three hours course credit will be offered. For an application, write or call Mauldin.

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# COASTWATCH

## Here comes coal

*It all began when the Arab oil producers doubled their prices in 1979. Suddenly Europe wanted to burn coal in its power plants. The demand for American coal grew huge, and coal ships waited months in line off Newport News and Hampton Roads, the big coal-handling centers of the East.*

*Almost overnight, coal companies began rushing to stake claims on new coal-terminal sites.*

*North Carolina was among the first places they looked. The state was near enough to the coal fields of Appalachia. There was already one deep-water port. The climate was mild, so coal wouldn't freeze on the docks during winter. By May, 1981, one company was ready to ship coal from Morehead city. Others were standing in line to buy land and file permits.*

*State officials called coal the "salvation" of the Morehead City port, which operated in the black for the first time since 1967. Federal officials lauded the industry for its role in helping with the balance of trade.*

*But while some sang coal's praises, others sang the blues. Citizens groups began to protest the prospects of coal trains and coal dust in their towns. Then, late in 1981, the European coal market weakened and coal's bright picture clouded. Would the whole coal boom vanish in a cloud of dust?*

*This month, Coastwatch examines the coal export industry in North Carolina, and its effect on the coast.*

Photo by Steven Wilson



*A coal train rumbles across the Piedmont on its way to the coast*



# Three towns, two ways of looking at a coal pile

Some say the face of Carteret County is black with coal dust. Others see no coal dust there at all.

By a similar quirk of optics, the mound of coal rising at the State Port coal terminal shows two different shapes to people watching it from windows in Beaufort, Morehead City and Atlantic Beach: Some see a mountain of prosperity; others, a heap of bad news.

"I can see that coal pile from my house, and that's not the view I came here for," says George Hammond, an Atlantic Beach resident. "I don't like the noise, the harassment of the trains, and the dust in the air. And, I don't like knowing that I might need to get to a hospital some day when a coal train is blocking all the crossings."

Hammond is a retired engineer who spends much of his time these days working with Carteret County Crossroads, a group campaigning against the development of coal terminals in the county. Hammond says the group's 300 members plan to press the state to prepare thorough environmental impact statements, not only for terminals proposed for Radio Island, near Beaufort, but also for the operation already under way at the State Port in Morehead City.

Hammond says that his group is angry because coal came rolling into the community over their objections and without, he says, enough study beforehand. The group cites a

previously untested law, section 143B-437 of the state's General Statutes, which states that "the Department of Commerce shall conduct an evaluation, in conjunction with the Department of Natural Resources and Community Development, of the effects on the state's natural and economic environment of any new or expanding industry or manufacturing plant locating in North Carolina."

But Clint Abernathy, assistant secretary of Commerce, says that the law was satisfied when the coal terminal, built by Alla-Ohio Valley Coals,

But coal company spokesmen say the coal, its dust and runoff are being contained on the site. They suggest that coal might be taking the rap for other sources of air pollution.

And Don McMahan, superintendent of bulk handling at the port, says that coal is a safe commodity for the port to handle.

"When they first told me we'd be handling coal, I didn't know what the dust problems might be," McMahan says. "But I've found coal to be wonderful to work with. It's easy on the men, it's heavy enough to handle well,

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*"When they first told me we'd be handling coal, I didn't know what the dust problems might be"—Don McMahan*

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received its permits from other agencies.

"The facility at Morehead had to get both an air quality and water quality permit," he says.

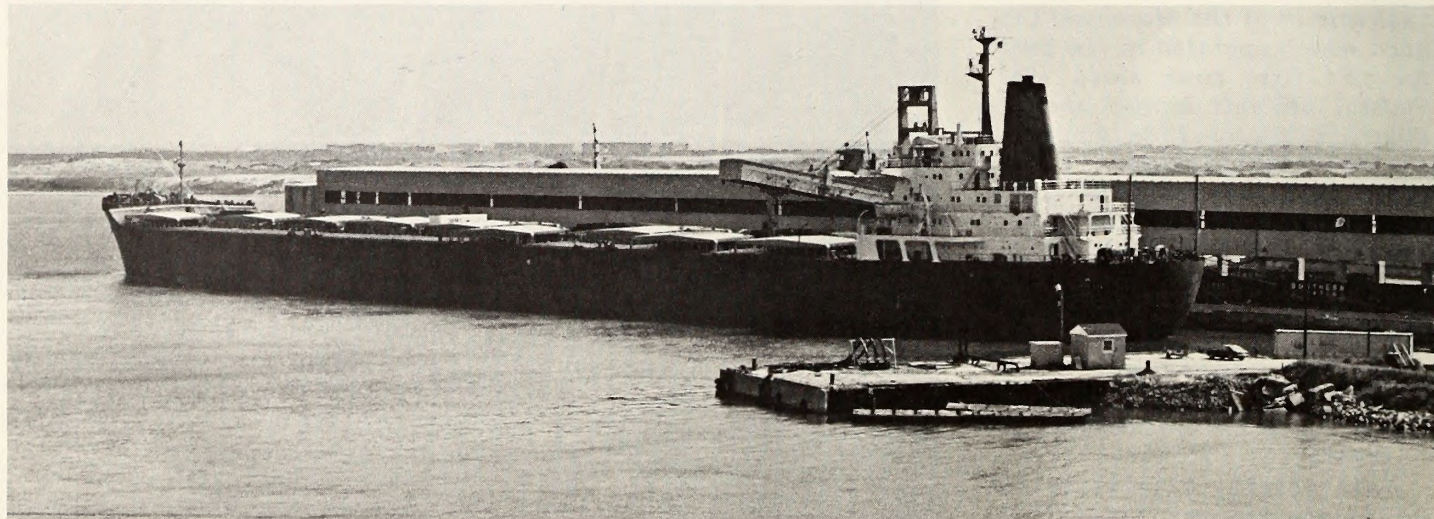
Opponents of the facility argue that its effects reach far beyond concerns over air and water quality, and Hammond says he believes the facility has not taken adequate measures to protect the environment.

"People are complaining about the dust, and if you can see the dust in the air, then you know some of it must be getting into the water," Hammond says. "And nobody knows yet what that might be doing to fishing around here."

and it's comparatively clean. If we didn't keep it wet, the dust would blow, but we use firefighting equipment to keep the piles hosed down. My office is fifty feet from the coal pile, and I don't have that much problem with dust."

McMahan says water from the piles seeps into two settling ponds where coal particles settle to the bottom. The water is then recycled through the pumper onto the piles, so that there is no discharge. When sludge in the ponds builds up, it is mixed with coal shipments and loaded on outbound ships. A dike-like embankment around the site prevents runoff from contaminating the waters of the Newport

*Photo by Bill Ray, Winston-Salem Journal*



*The state's first load of export coal went out on the Chihaya in May, 1981*



estuary, McMahan says.

"It's helped the port," McMahan says of the coal. "We were set up here to handle phosphate, but the phosphate shipments never have come up to the levels we expected, so we have the capacity to carry coal. It's meant about forty-five new jobs and sixteen others part-time."

During 1981, the State Port at Morehead City showed a profit for the first time since 1967. Coal exports get the credit.

All of the coal shipped out so far has belonged to Alla-Ohio, which leases the site of the new terminal from the state. The coal is mined mostly in West Virginia and Kentucky and travels by rail to the terminal, where it is loaded on ships bound for Europe. The product is called steam coal, because it is used to fire steam-generating power plants. Steam coal is less dense and somewhat less hazardous than metallurgical coal, which is mixed to order on the docks. The Newport News and Hampton Roads area of Virginia handles most of the country's exports of metallurgical coal.

The first coal ship from North Carolina loaded 62,635 short tons on May 8, 1981. McMahan says that the port shipped coal at a rate amounting to 2 million tons per year until financial troubles forced Alla-Ohio to suspend shipments in November, 1981.

But between the coal fields of Apalachia and the covered conveyor that feeds the big ships, coal is raising a ruckus along the rail line. In New Bern, townspeople are worrying about 75-car coal trains rattling their historic district, which the railroad bisects. And in Morehead City, where trains and traffic share Arendell Street, the town's main avenue, trains turn and unload at the State Port nearby, sometimes tying up as many as nine city blocks for 20 for 30 minutes. There are 36 grade crossings on Arendell Street alone.

But the coal terminal's defenders say there will be ways to unsnarl both the traffic and the critics.

"We'll get accustomed to coal," says Roy Stevens, director of the Carteret County Economic Development Council. "I can think of things I'd rather have here than a coal terminal. But right now, that is who is interested."

—Neil Caudle

Photo by Ron Chapple



*Workmen use water hoses to control dust at the terminal*

## Trains and trouble at mayor's door

From the mayor's office in Morehead City, Bud Dixon can rock back in his chair and watch the coal trains rumbling down Arendell Street. Dixon lives and works on that street, within rattling range of the coal cars coming in and out of the State Port nearby.

Lately, Dixon has been feeling the weight of those cars in more ways than one. He is the mayor, but he is also the president, by appointment, of the Atlantic and North Carolina Railway between Goldsboro and Morehead City. He presides over the State of North Carolina's controlling share of the railroad, which is leased to Southern Railway. So state officials' enthusiasm for a new coal industry has not been lost on Bud Dixon. But neither has his own town's dread of coal. And he has doubts about how the costs and benefits of exporting coal will balance out in his community.

"We know that Morehead City cannot take any more transportation problems than it already has," Dixon says. "And the majority of our people here are against coal coming in. They associate it with what they've seen up at Newport News. They just know that coal is a dirty commodity, and they don't want it, period."

"We're not really in a good location for industries like this to come in and develop," he adds. "We have always relied on tourism and commercial fishing for much of our economic growth, and those industries just can't stand too much industrial development around them."

But while strong voices sound off on both sides of the issue, Dixon says there's not much he can do right now but wait. He waits for the results of a study, conducted with a \$30,000 grant from the state, of how the trains will affect the town's underground utilities, tourist trade, emergency services and property values. He waits for the N. C. Department of Transportation to finish its study of rail traffic problems in the New Bern-to-Morehead City corridor, a study on which the development of Radio Island as a port is waiting. And, he waits for Southern Railway, the state and the coal companies to agree on just who should foot the bill for solving the transportation bottlenecks.

Meanwhile, he goes to meetings where officials and coal company representatives assure him that nobody wants to see six heavy coal

*Continued on next page*





*Coal pile rising near the railway*



*Mayor Bud Dixon of Morehead City*

trains a day descending on downtown Morehead City. But despite their assurances, Dixon says he doesn't know what recourse his community might have if the trains come rolling in on their way to a new terminal on Radio Island.

"I don't think it's going to happen," Dixon says, "but I don't know yet what we could do to stop them if it did."

The Coastal Resources Commission has made the development of coal terminals on the island dependent on state-approved port and transportation plans that would prescribe ways of untangling the traffic and environmental problems, both on the rails and around the harbor. And, Coastal Management officials say they believe any development would have to be consistent with those plans, or the development could not be approved.

Right now, that message seems to imply that coal headed for Radio Island would have to bypass

Morehead City's business district, either by a new railway or by some alternative means, such as slurry pipelines or barges.

But the question remains: Who'll pay for such improvements? Marvin Wilson, Southern Railway's chief engineer in the company's Atlanta, Georgia office, says he doubts his company will sink millions into a new railroad route without some assurance that the coal industry's boom doesn't turn to bust.

"We've already laid some new welded rail between New Bern and Morehead," Wilson says, "and if you're talking about just getting the track we've got now ready for more traffic, we could do that fast—this year. But if you're talking about bypasses around New Bern or Morehead, that's something else."

Wilson says estimates of \$50 million to \$100 million for a rail bypass around either city are "on the low side."

"It's going to be hard to get around

Morehead City," he explains. "To the north, there's some valuable residential area. To the south, there's water. It would take three to five years to buy up the right-of-ways and build."

(Gulf-Interstate, the company planning a large coal terminal on Radio Island, hopes to be in business by 1984 with an initial capacity of about five million tons a year.)

While Southern is unlikely to sink millions into bypasses unless it knows coal shipments will pay off, the coal companies are unlikely to make guarantees until they know they can get their coal to sea. And, state officials are reluctant to approve plans for new terminals until some headway is made on the transportation problems.

"They're just going to have to get together and work something out," Dixon says. "They've all got something to gain from it."

—Neil Caudle



# Coal pays, but the costs are hard to figure

So far, the coal shipped through North Carolina has generated about as much reaction in coastal communities as it has electricity in Europe. But between the cheers and jeers, the question most often asked is: Will handling coal cost us more than it is worth?

The answer is unclear. But even so, assistant secretary Clint Abernathy says the State Department of Commerce is aggressively seeking the coal export industry.

"We go after any commodity that can be moved through the ports," he says. "The tonnage over the docks helps local economies and brings revenue to the port. In the case of Morehead City, about ten million dollars will go into the local economy this year (1982) because of jobs associated with handling coal."

But Morehead City mayor Bud Dixon is skeptical. "I can't see how sixty jobs will mean ten million dollars," he says. "There's no question it will help some, but some of the benefits may be offset by decreasing property values and tourist trade."

Abernathy dismisses the view that increases in coal shipments will spell declines in tourism and fisheries. "We have not been able to identify any real costs," he says. But he adds that the department has not conducted a cost-benefit analysis to determine specifically what the economic trade-offs might be.

Most of the information available on the costs and benefits of the coal export industry has been compiled during two studies. One of them, conducted by the state's Department of Natural Resources and Community Development (NRCD), produced a report last October called "Coal Export in North Carolina: A Review of the Issues." The other study is being conducted by the UNC Institute for Transportation Research and Education, which has prepared a series of comprehensive reports on energy transportation in the coastal area. Together, the reports offer state officials a primer in the brand-new business of coal exports and the problems it poses for North Carolina.

The reports do list a range of economic benefits the coal industry promises: jobs, new businesses serving

the export trade, capital investments, and revenue for the ports. But the reports also detail an array of problems, costs and risks.

As the coal industry develops in North Carolina, the state will be grappling with several key issues. Here are some of them, in brief:

## Rail Transportation

If the coal industry's estimates prove accurate, 50 million tons of coal a year will cross North Carolina by 1985. It would take about 35 trips a day, using coal trains 75 cars long, to get the job done. About a dozen of those trips—six in, six out—would pass through Morehead City. And, unless some kind of bypass is built, the trains would tie up traffic at each grade crossing for a total of about an hour and a half each day. The remaining trains would travel to Wilmington—about 18 trips a day—and a proposed slurry pipeline site at a yet-undecided location.

For now, the only way to move coal across the state in quantity is by rail. Can the state's rail system stand up to the test of 50 million tons of coal a year? Here are the weak links:

—In Morehead City, the state will probably recommend some sort of bypass around the town. But for now, rail planners won't say where a bypass might be constructed. Any such line would almost certainly intersect key

fishing grounds or nursery areas. "The cost of getting over wetlands is extremely high," says Mark Boggs, a planner who is helping conduct the state's study of coal transportation in the area. "Right now, we don't have any route in mind."

—In New Bern, gateway to the Morehead City corridor, the single railroad splits Hancock Street and train traffic may endanger some of the town's historic structures. A study funded by the state's Office of Coastal Management is investigating the possible effects of vibration and noise on the historic district, and the results are due this spring. Rail planners point out that a bypass might be possible, though very expensive, around New Bern.

—Two Southern Railway routes between Raleigh and New Bern both have problems. One passing through Chocowinity serves the Texas Gulf complex at Aurora and regularly handles hazardous chemicals. Trains on the line must use a two-mile wooden trestle to cross the Neuse River into New Bern, and neither the track nor the trestle is designed for heavy trains. The alternative route, through Goldsboro, will require rebuilding to accommodate heavy coal-train traffic.

—Trains headed for the proposed Williams Terminals site would share

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*Photo courtesy of ITR*



*Arendell Street, Morehead City*



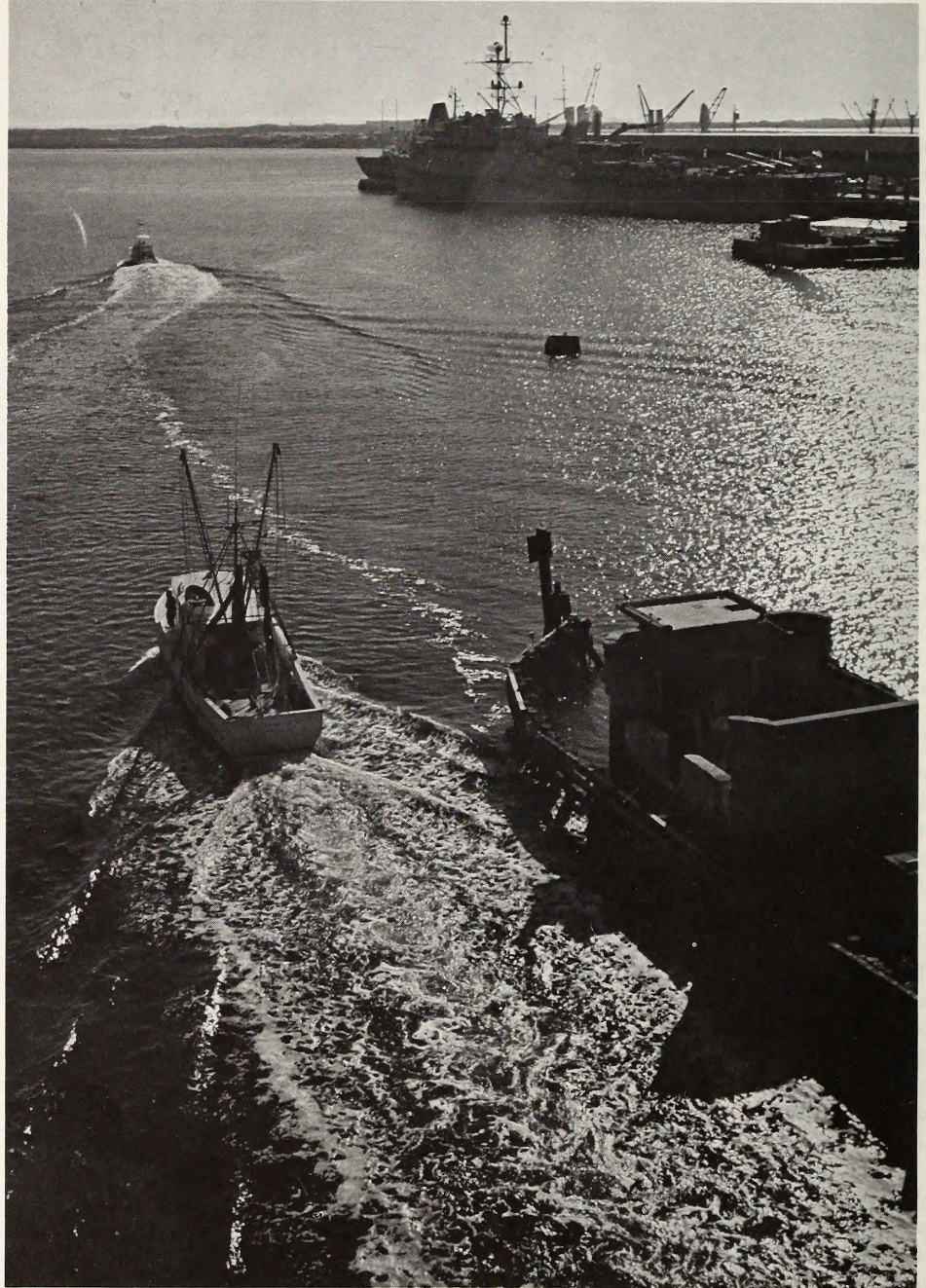
U. S. Army-operated track with trains carrying ammunition and chemicals through the town of Boiling Springs, where residents and army engineers have reported sinkholes forming under the railroad and trestle. Traffic moves there at 5 mph.

There are other such problems with the coastal region's rail corridors—some already being remedied. According to the studies, most of the track in the area would have to be improved in order to meet traffic projected for 1985.

## Navigation

Overhauling the railroads won't solve all the transportation problems facing the coal export industry in North Carolina. At the ports and terminals, the question is how to float big shipments in relatively shallow waters. The tendency among coal transporters is toward bigger ships and shipments, which produce higher profits. At Morehead City, one of the few "deep-water ports" in the East, the channel and turning basin are dredged to only about 42 feet in depth. Gulf-Interstate, the Texas company that wants to develop a large terminal on Radio Island and share the channel with the port, has already announced that it wants to dredge the channel to 55 feet, initially, so that it can handle ships of a moderate weight-class. The company has said it hopes the channel could eventually be dredged to 65 feet or more, to accomodate even bigger ships. The bottom of the channel is sandy and easily dredged, but achieving a depth of 55 feet would necessitate doubling, at least, the length of the channel, to over seven miles. Jetties are proposed to protect the channel. Sites for depositing the dredge spoil are reaching capacity, and, the costs of such operations are very high.

Terminals around Wilmington would have another obstacle. The Cape Fear River can not be dredged much deeper than its present 38 feet without striking limestone formations and rock outcroppings. Says Paul Cribbens, a North Carolina State University engineer who has been studying the problem as part of the Transportation Institute's study: "It looks like we'll have to consider the possibility of shallow-draft boats rather than dredging in the Wilmington area."



*Fishing boats share channel with ships at State Port*

Cribbens has studied alternatives to the rail-to-port transportation scheme and offers three "scenarios" that he says deserve further investigation:

—In either the Neuse or Pamlico river, cranes could load coal from rail cars onto barges, which could in turn make their way to port, or rendezvous with coal ships at sea. This plan would help avoid the New Bern-to-Morehead rail corridor.

—In Wilmington, where waterways are less crowded, wider, shallow-draft ships could be used, sparing the need for deeper dredging.

—Coal stockpiled at a convenient location could be moved in underwater pipelines to ships waiting in an offshore terminal, well clear of congested coastal areas.

But as Cribbens and others point out, all of these plans have costs and risks. Barges loaded with coal could clot waterways and create traffic conflicts. Spills and accidents could have grave consequences for aquatic life in the rivers. Projections for a slurry pipeline proposed by Whelebrater-Frye indicate the pipeline would pump several million gallons of water out of



the ground each day, possibly affecting local water quality and supplies.

### Environmental Risks

Coal transport is so new to North Carolina that nobody knows exactly what the environmental impacts might be. But the biggest concern is over so-called heavy metals, elements found in coal and its dust that can be toxic if they are sufficiently concentrated.

"There are thirty heavy metals in coal runoff," says Susan Schmidt, a researcher who has studied the hazards of coal for the Office of Coastal Management. "Maybe twelve of those can accumulate in fish and in the food chain."

Coal contains such elements as aluminum, arsenic, cadmium, chromium, copper, mercury, nickel, lead, selenium, sulfate, iron, and manganese.

"Aquatic species can magnify metals," Schmidt says. "The best example is oysters, since they magnify metals in the water column by something like four thousand times."

Schmidt says there's no reason to believe that the metals from coal pose an immediate threat to fisheries in the

Neuse and Pamlico estuaries, even though heavy metals have been blamed for cancer and gene abnormalities in humans.

"Right now, the waters are relatively pristine," Schmidt says. "It's just going to take careful monitoring to keep them that way."

Patrick Whaley, a scientist at the Duke University Marine Laboratory in Beaufort, has analyzed coal samples from piles at the State Port terminal and says that, while there are heavy metals present in the samples, they are not present in great concentrations. "The levels are not high enough to be alarming," Whaley says. The coal samples were sub-bituminous, a type of coal less dense than the harder metallurgical coals.

But Whaley adds that even though the amounts of heavy metals seem low, there is still good reason to be cautious with coal, its dust and runoff.

Managing coal-pile runoff and dust from the Morehead City and Radio Island sites is especially crucial, since tides flush adjacent waters into the Newport River estuary, one of the most productive in the state.

But the NRCD report indicates that

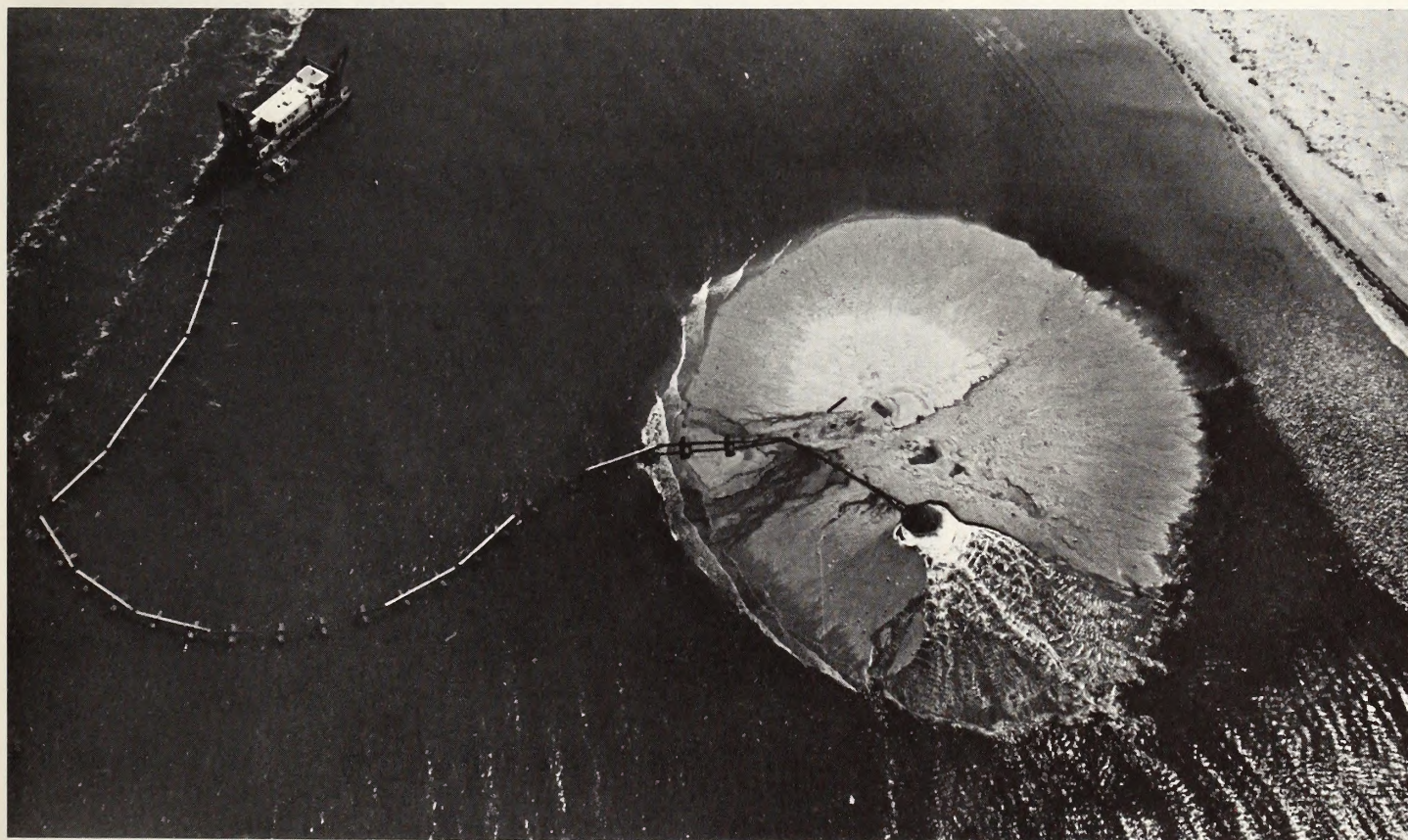
there is perhaps more risk to the state's fisheries from ship and barge traffic and dredging operations than from the coal itself—problems that would likely accompany the development of any export trade.

The report concludes that "the most important unresolved problem may be the cumulative effects of dredging new channels and deepening existing ones. . ."

What is the price tag for resolving such issues? The answer is elusive, but experts agree that the problems will require more research, careful monitoring and thorough planning. And those efforts have costs.

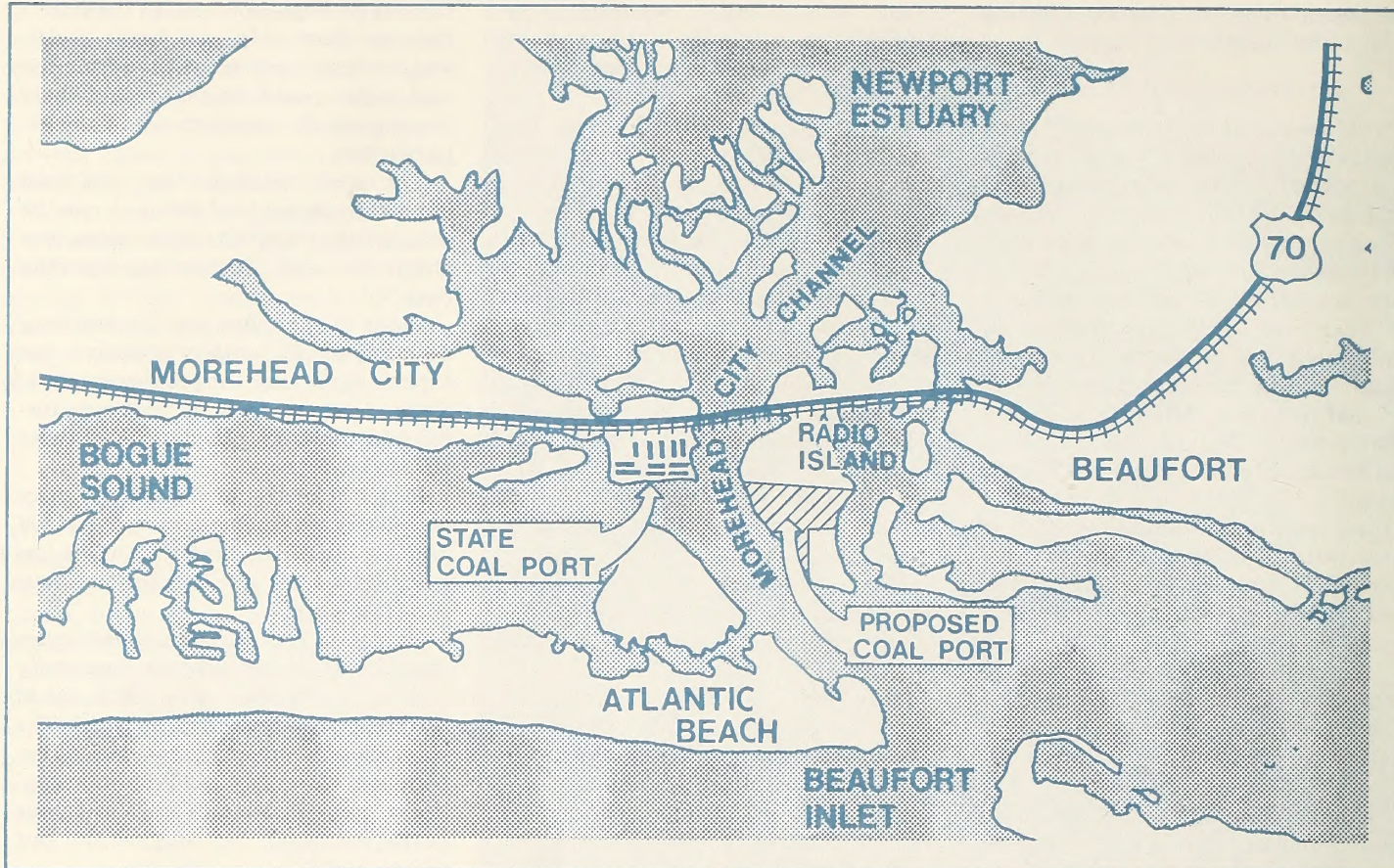
Roger Schecter, of the state's Office of Regulatory Regulations, helped prepare the NRCD report, and he has reached at least one conclusion about the state's role:

"Most of the environmental issues could be addressed through regulatory coverage," Schecter says. "But one of the things that concerns us is that the state doesn't have a great deal of experience with this kind of industry. We're going to have to start using our authority, and be tougher in our enforcement."



*A channel dredge builds a new dredge-spoil island in a North Carolina inlet*





Map shows coal trains' route through Morehead to terminal sites

## Here's the lineup: one on base, seven on deck

At least eight companies want to build coal export terminals in North Carolina. One of them, Alla-Ohio Valley Coals, has already set up shop. The others have either sought permits or are preparing to do so. Here is the list:

- The American Coal Export Company has secured all the necessary permits to build a terminal on an 80-acre site along the west bank of the Cape Fear River just north of Wilmington. The company plans a terminal with a capacity of three to seven million tons a year. Coal trains would reach the site by the Seaboard Coastline. American Coal plans to dredge the river channel from the US 117 bridge to the site. The company plans to finish its construction in October.

- Cleancoal Terminals, Inc. has permits in process for developing a three-million-ton-per-year terminal on a 20-acre tract owned by Seaboard Coastline in the northern downtown

area of Wilmington. Coal trains would reach the site through northeastern Wilmington and, because the tract is small, would have to uncouple and recouple off the site. A city report on the proposed terminal found that it posed a noise problem not covered by state regulations, but went on to recommend that the city not delay the project. The company plans to have the facility operating in September.

- The Williams Terminals Company is proposing to build a coal export facility south of Wilmington on the Cape Fear River in Brunswick County. The company plans to open the terminal at about half its projected 20 million-ton capacity on a 400-acre tract just north of Southport. Coal trains would reach the site by the Seaboard Coastline track and the U. S. government rail to the Sunny Point Military Ocean Terminal. The company plans to be operating at the site in 1984.

- Whelebrater-Frye, Inc. has

proposed a slurry pipeline for either of two sites, one in Carteret County, another near Scotts Hill in Pender County. The company plans an initial capacity of 12 to 14 million tons per year. At the site, coal would be mixed with water and then piped under water to a loading buoy about 10 miles offshore. Permits have not been filed, but the company plans to be operating in North Carolina in 1985.

- Utah International, Inc. has proposed a terminal to export coal from a site on the Brunswick County side of the Cape Fear River, about 10 miles south of Wilmington. The facility would open with a capacity of five to seven million tons a year, with plans for expanding to 15 to 20 million tons. No completion date has been set.

- Carolina Coal Company has proposed using the State Port Terminal in Wilmington to export four to nine million tons of coal a year. Plans for this terminal have not been set.

- Gulf-Interstate has proposed a



coal terminal for Radio Island, near the State Port in Morehead City. The capacity of the 77-acre site would be five million tons per year initially, 20 million tons projected. The company plans a completion date of 1984, and is expected to file in February for permits to build its \$60 million facility. Permits could be approved as early as July, but are contingent upon the state's approval of both a port development plan and a study by the Department of Transportation. The

Coastal Resources Commission, which last year reclassified Radio Island as a "rural port", did so on the condition that the plan and the study first resolve land-use and transportation problems associated with developing the site for handling bulk products.

• Alla-Ohio Valley Coals, Inc. has developed a \$4.5 million dollar terminal on a site it leases at the State Port in Morehead City. The company began operating at the site in April, 1981, and handled about one million

tons before shipments were suspended in November, 1981, when the company filed under Chapter 11 of the bankruptcy law. The terminal has a capacity of about three million tons a year. The company says that it intends to resume shipments and honor its lease with the state, which expires in 1984. The company, which now owns the only coal export facility in the state, has also proposed developing a 10-to-15-million-ton facility on Radio Island.

## For now, more fizzle than steam in coal market

Sam Holcomb is on the spot. Last year, his company's new coal terminal opened to mixed reviews in Carteret County. Then, in November, the operation shut down to reorganize under Chapter 11 of the bankruptcy laws. Now, the company's future is in the hands of its creditors and referees, and the coal waits in piles while recession and a weak European market dim last year's euphoria over coal.

Holcomb is the regional manager for Alla-Ohio Valley Coals, a parent company of 28 coal firms. Eight of those firms have filed to reorganize, and one of them is the Morehead City Coal Terminal.

"We're optimistic that the Morehead City facility will pull through in good shape," Holcomb says. "That terminal is the flagship of our company, because it is the only export terminal we own. It is critical in the company's planning."

But Alla-Ohio's troubles were only the first in a series of sour notes sounded this winter about the prospects for a booming coal industry in North Carolina. An oil glut slowed European power plants' conversion from oil to coal. Recession wiped out the spot market for coal. Polish coal mines reopened after being shut down much of last year.

And, there were signs the nation was overdeveloping its export terminals. *Fortune* magazine reported in December that "if all the proposed coal terminals are built, the U. S. will have coal-loading capacity of 628.5 million tons per year—vastly in excess of what is needed." The magazine's report didn't take into account the seven or more terminals proposed for North Carolina. But it did predict that many of the proposed projects around the country will never be built.

Because of these reports, some state officials are wondering aloud if the alarm over a coal boom hasn't been premature. Others argue that planning now will help head off other growing pains in the state's future development.

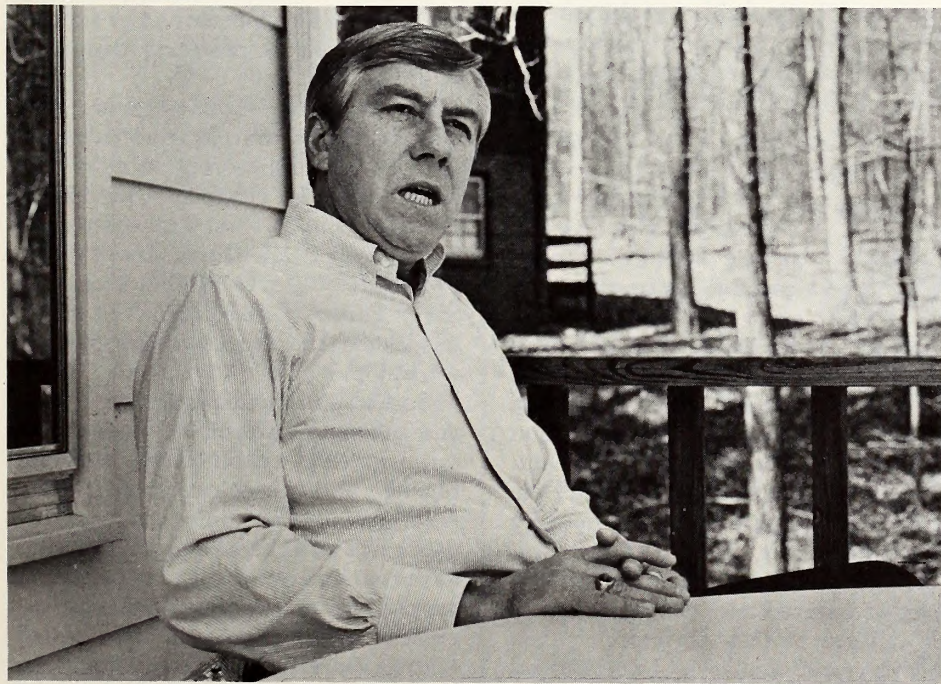
Will there be enough coal business to go around?

"The world coal market is cyclical," Holcomb says. "It has peaks and valleys. It will be the companies who can get long-term contracts that will survive. There will be some casualties, but nobody feels that the market is not going to come up."

Despite his company's financial woes, Holcomb says Alla-Ohio's early start has given it several options and a jump on the competition.

"We still have a prime interest in developing a bigger terminal on Radio Island," he says. "But if that doesn't come to pass, because of transportation problems or some other reason, we could still be very profitable where we are. We could bring in one unit train plus a few other cars a day, just as we've been doing, ship two million tons a year, and make a profit."

Photo by Steven Wilson



Alla-Ohio's Sam Holcomb at home in Cary, N.C.



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



Again this year, UNC Sea Grant will award graduate fellowships for students studying in marine science fields. Each fellowship includes an annual stipend of \$7,000 for doctoral students and \$6,000 for masters students. Tuition and fees are paid and an additional \$1,000 is provided for supplies and incidentals. Two fellowships are available for 1982. Applications must be received no later than April 1.

Prospective doctoral and masters students from any recognized public or private institution are eligible. Recipients must be planning to attend the University of North Carolina at Chapel Hill (UNC-CH), North Carolina State University (NCSU) in Raleigh or East Carolina University (ECU) in Greenville.

Applicants must be registered, full-time students, may not hold other graduate assistantships, must remain in good standing with their institutions and must make satisfactory progress toward receiving their degree. Applicants must also submit written proposals outlining their proposed plans for research and study.

For more information and applications, contact the Department of Marine, Earth and Atmospheric Sciences at NCSU, the Curriculum in Marine Science at UNC-CH or the Institute of Coastal and Marine Resources at ECU. Information is also available from the graduate schools of the participating universities and from UNC Sea Grant, 105 1911 Building, NCSU, Raleigh, N.C. 27650.



The minimum setbacks for coastal construction are the subject of another Sea Grant mini-grant. The researchers are Alan Stutts and Chrystos Siderlis from North Carolina State University's Department of Recreation and Resources Administration.

Enforced since 1979, the minimum construction setback requirement is calculated on a 30-year erosion rate which results in a setback as short as 60 feet or as long as 400 feet. (The average annual erosion rate is two feet.) As a general rule, the further a structure is set back from the ocean, the greater its resistance to hurricanes and erosion. However, many builders and property owners are using the minimum standard as a maximum, building right at the line.

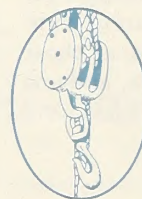
Working with Spencer Rogers, Sea Grant's coastal engineer, Stutts and Siderlis will be studying a sample area of the coast, measuring setbacks. This data will be combined with interviews with property owners and state and local officials. Their objective is to determine if the setback requirements have adverse effects, encouraging development further seaward and increasing the potential for loss of property.



Several Sea Grant people attended conferences in February to present their work. Ron Hodson, Sea Grant's associate director and project director of the NCSU Aquaculture Demonstration Project, and Randy Rouse, a technician at the project, traveled to the World Mariculture Society's meeting in Charleston, South Carolina. Technical sessions at the international meeting covered new developments in the culture of fish, shrimp, lobsters, crawfish and molluscs. John Foster, also of the Aquaculture Demonstration Project and Bill Rickards, direc-

tor of Virginia Sea Grant, also presented a paper and poster on teaching eels to eat pelleted feeds. (Rickards was UNC Sea Grant's associate director before he moved to Virginia last spring.)

John Sanders, Sea Grant's coastal weather awareness specialist, was also in Charleston for the Mid-South Atlantic Coastal Hazards Conference. Sponsored by the National Oceanic and Atmospheric Administration, the U.S. Geological Survey and the Federal Emergency Management Agency, the two-day conference presented information and programs on agencies and businesses that deal with hurricanes, floods, erosion, oil spills, pollution and other coastal hazards. Sanders also participated in the poster session.



Fuel costs have pinched harder and harder at fishermen's pocket-books in recent years. As an answer to the problem, fishermen and others are considering sail power as an alternative or supplemental means of powering their vessels.

To learn more about sail power, the Virginia Sea Grant Marine Advisory Service is cosponsoring a workshop May 19-21 in Norfolk, Virginia on "Applications of Sail-Assisted Power Technology." The University of South Florida College of Engineering and Sail Assist International Liaison Associates, Inc. are also sponsoring the workshop.

Conference participants will discuss and evaluate realistic applications of sail-assisted power on fishing, research, towing and cargo-carrying vessels. Also during the conference, participants will examine the practical issues associated with constructing, retrofitting and working sail-assisted vessels; the economics of sail-assisted vessels; Coast Guard certification; insurance pros and cons; financing, and realistic uses of sail-assisted power on



fishing and oceanographic vessels. In addition, data on fuel savings will be presented and evaluated.

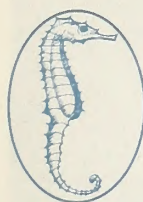
At least two working sail-assisted vessels will be at dockside for the conference, including the *Norfolk Rebel*, featured in the February 1981 *Coastwatch*.

Conference registration is \$60 and includes two lunches plus conference materials. Lodging arrangements should be made directly with the Omni International Hotel, 777 Waterfront Drive, Norfolk, Va. 23501.

For more information contact, Jon Lucy, Sea Grant Marine Advisory Service, Virginia Institute for Marine Sciences, Gloucester Point, Va. 23062 or call (804) 642-6131.

In a second year of budget cuts, President Ronald Reagan has again proposed reducing the federal Sea Grant program budget to phase-out levels. The proposed budget submitted to Congress allows only \$1.7 million for Sea Grant in 1983, to be used to shut down the program.

Efforts are being made to try to restore the Sea Grant budget to operational levels.



**James D. Murray** joined UNC Sea Grant March 5 as the new director of marine advisory services. Murray comes to North Carolina from New Jersey,

where he served as director of the New Jersey Sea Grant Marine Advisory Services. He has also worked in the Minnesota and New York Sea Grant Programs.

Murray received his undergraduate degree in economics from Syracuse University and his master's degree in resource management from the State University of New York at Syracuse.

Murray replaces J.C. Jones, who retired as director of the marine advisory services during 1981.

**UNC Sea Grant Director B.J. Copeland** will chair a committee set up by the Council of Sea Grant Directors to establish national priorities for estuarine research during the next five to 10 years. Copeland says the committee will work closely with the Office of Sea

Grant in Washington, D.C., to determine which estuarine projects should receive federal funding from Sea Grant.

One top concern the committee will examine, Copeland says, is the relationship between management of freshwater intrusion and estuarine production, a major problem facing many coastal states including North Carolina.

**Spencer Rogers**, UNC Sea Grant's coastal engineering specialist at the N.C. Marine Resources Center at Ft. Fisher, has received an academic appointment as senior engineering extension specialist with the North Carolina State University Department of Civil Engineering. Rogers now has joint appointment in Sea Grant and the civil engineering department.

North Carolina's Atlantic graveyard has claimed more than its fair share of wrecks, but none more famous than the Civil War ironclad U.S.S. Monitor. Beginning April 23, the N. C. Marine Resources Centers at Fort Fisher, Bogue Banks and Roanoke Island will feature a display of the Monitor, which sank off the Outer

Banks in 1862. Artifacts and photos tell the history of the Monitor and the dives which brought up pieces of the ship and its contents. Parts of the exhibit are on loan from the National Oceanic and Atmospheric Administration, the U.S. Navy and the Division of Archives and History. For more information about the exhibits, contact the Office of Marine Affairs at 733-2290.



**Project CAPE** (Coastal Awareness in Public Education), a project by the Dare County Schools, has four marine education units available for educators to purchase. For eighth-grade study, Project CAPE offers *Field Studies for the Coastal Environment*; for fifth and sixth graders, *Coastal Livelihoods and Crafts*; for third and fourth graders, *Cape Hatteras Lighthouse*; and for kindergarten through second graders, *Coastal Ecosystems*. The lighthouse unit also includes a color filmstrip.

Several of these units were written by East Carolina University graduate

*Continued on next page*

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, Box 5001, Raleigh, N.C. 27650.

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City•State•Zip Code \_\_\_\_\_

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I am in the following line of work:

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|---|--|
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| <input type="checkbox"/> City/County government | <input type="checkbox"/> Marine recreation               |
| <input type="checkbox"/> Commercial fishing     | <input type="checkbox"/> Mass media                      |
| <input type="checkbox"/> Educator               | <input type="checkbox"/> Seafood processing/marketing    |
| <input type="checkbox"/> Farming                | <input type="checkbox"/> State government                |
| <input type="checkbox"/> Homemaker              | <input type="checkbox"/> University professor/researcher |
| <input type="checkbox"/> Lawyer                 | <input type="checkbox"/> Other _____                     |

Coastal property owner ☐ yes ☐ no    Boat owner ☐ yes ☐ no



students on UNC Sea Grant scholarships. For more information about the units, write Project CAPE, Dare County School Board, P. O. Box 640, Manteo, N.C. 27954.

When the Girl Scouts of America decided to choose water as their 1982 theme, Sea Grant was a natural place to come for information. Raleigh area girl scouts held their girl scout expos March 6 in local malls, providing demonstrations on water conservation and use. UNC Sea Grant Director B. J. Copeland acted as adviser to one girl scout troop and Sea Grant materials were provided to others.



*Implications of Proposed Management Measures for the North Carolina Sea Scallop Industry*, by John R. Maiolo of East Carolina University,

describes the impact of a management measure proposed by the New

England Fishery Council on North Carolina scallop fishermen and seafood dealers. In August 1980, the New England Council proposed that only scallops that meet a 30-count standard (30 meats per pound) could be harvested from New England waters. North Carolina fishermen and shuckers argued such a ruling would put them out of business. Maiolo explores the socio-economic impacts of these proposed changes in his paper.

For a copy of the paper, write UNC Sea Grant, P. O. Box 5001, Raleigh, N.C. 27650-5001. Ask for publication number UNC-SG-WP-81-7. The cost is \$1.

*Developing a Growth Management System for Rural Coastal Communities*, by David Brower, Candace Carraway and Thomas Pollard of the Center for Urban and Regional Studies at UNC-Chapel Hill, describes the methods rural coastal communities can use to influence the characteristics of growth and achieve community land-use goals and policies.

For a copy of this publication, write

UNC Sea Grant. Ask for publication number, UNC-SG-WP-81-9. The cost is \$3.50.

*Wind-Wave Climatology and Wind Tides for Fort Raleigh Wave-Gauge Site, 1979*, by C. Ernest Knowles of the NCSU Department of Marine, Earth and Atmospheric Sciences, is the latest in a series of Sea Grant working papers.

To receive a copy of this working paper, send \$1.75 to UNC Sea Grant. Ask for publication number UNC-SG-WP-81-8.

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## COASTWATCH

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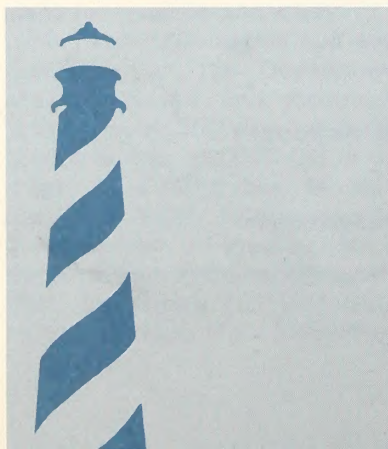
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APR 5 1982

# COAST WATCH

Photo by Steven Wilson



The hard clam, *Mercenaria mercenaria*

## Getting a clam Out of bed

North Carolina fishermen say there's more than one way to get clams from the estuary to the table. They rake, tong, "sign," kick and dredge hard clams from their estuarine beds.

Found from Nova Scotia to the Yucatan, the hard clam (*Mercenaria mercenaria*) is classified as a bivalve mollusk, meaning it has two valves or shells and a soft body. The hard clam lives in coastal creeks, bays and sounds, burrowed several inches below the sediment, feeding on food filtered from the water.

Clams are graded by size and priced accordingly. The chowder clam, whose name implies its use, is the largest hard clam, but it brings fishermen the smallest return. The cherrystone, a medium-sized hard clam bringing medium prices, is served raw or steamed. The littleneck, the smallest and most expensive hard clam, is used in the half-shell trade and is also steamed. Clams bring from about eight to 13 cents apiece, depending on the size and the supply.

Indians, the first clammers along the eastern United States shoreline, ate the soft-bodied clam and used its shell to make bead necklaces called wampum. Wampum originally had a sacred significance, but after the arrival of the European settlers it was used as money for trade.

Traditionally most clammers, recreational and commercial, have used either rakes or tongs to unearth clams from the estuarine bottom. Most hand clamming occurs during warmer

*Continued on next page*





*A Cedar Island clammer*

months, says Marcus Hepburn, a researcher at the Institute for Coastal and Marine Resources at East Carolina University. As part of a UNC Sea Grant research project examining hard clams, Hepburn is finding out

more about the people who clam.

Hepburn describes one method of harvest called "swimming for clams." "The person immerses himself in the water and crawls along the bottom on his hands and knees," he says. "All the while he's feeling the bottom for clams with his hands, knees and feet. When he finds a clam he deposits it in a tub that sits in an inner tube. The tube and tub are pulled along by a rope attached to the clammer's leg."

Lionel Gilgo, a retired clammer from Atlantic, says he clams by the sign. It seems clams sometime give away their position while they're feeding by making a small hole in the sand. "You've got to know that sign from the other signs on the bottom," Gilgo says. "They'll only sign certain days and they only feed on the tide, but never on the ebb tide. And they won't feed every day."

Until the mid-1970s all North Carolina clams were harvested by hand. But then two mechanical methods of harvest were introduced, kicking and dredging. Kicking and dredging are winter fisheries, limited by the N. C. Division of Marine Fisheries. Last year, 30 percent of the 1,458,000 pounds of clams harvested in this state were kicked, four percent were dredged and 64 percent were harvested by hand methods. Clams brought North Carolina fishermen more than \$5 million in dockside revenues during 1981.

After the introduction of mechanical harvest and a jump in clam prices from seafood dealers, clamming became an important seasonal fishery in North Carolina. Clam landings doubled and dockside values quadrupled between 1977 and 1979 alone, Hepburn says.

Though clam landings have remained constant in recent years, two problems face the fishery—exploitation and pollution. Fishermen, scientists and resources managers are worried that clam stocks may be becoming overfished. Sea Grant researchers Charles Peterson of the UNC Institute of Marine Sciences and Marcus Hepburn are taking a closer look at the hard clam and its harvest methods, hoping to answer some important questions about the fishery.

Some clams are unharvestable because they bed in waters polluted by sewage treatment plants, malfunctioning septic tanks, farm drainage areas, construction sites or industry. Mark Sobsey, another Sea Grant researcher from the University of North Carolina at Chapel Hill, is examining contamination in oysters and clams.

So while the hard clam lies snuggled beneath its estuarine blanket, those of us topside worry about its fate. Fishermen are concerned about having enough clams to fish; resource managers are worried about managing stocks, and scientists are anxious to learn more about both the clam and the people who fish for them.

## Clams today, none tomorrow, say kickers

Thin sheets of ice weave a collar around Core Sound during a mid-January freeze down East. Charles Gilgo, a clam kicker, sits by the fire in his Atlantic home, hoping for a thaw.

"I came back in this morning after my first three bags froze on the boat," Gilgo says. "It was too cold for me."

A cold snap may keep Gilgo off the sound for a few days but he knows it will pass. But what really worries him is a bigger problem—one that could keep him by the fire in winters to come. And that problem, he says, is a scarcity of clams in Core Sound.

"I got started kicking because the money was good," Gilgo says. "You could make better money clamming during the winter than doing any-

thing else. I've stayed in it because the money got even better and I didn't have to go far from home to clam. But if we continue kicking this year and next, there may not be many clams left in Core Sound."

Gilgo is worried that the clam stocks in Core Sound are being overfished and he may no longer have a winter fishery to rely upon.

His father, Lionel Gilgo, blames the declining harvests on mechanical kicking. Before retiring this fall, Lionel raked clams from Core Sound for 15 years.

"Kicking has just about destroyed Core Sound," he says. "They've caught about every clam out there and now they're very, very scarce. Raking

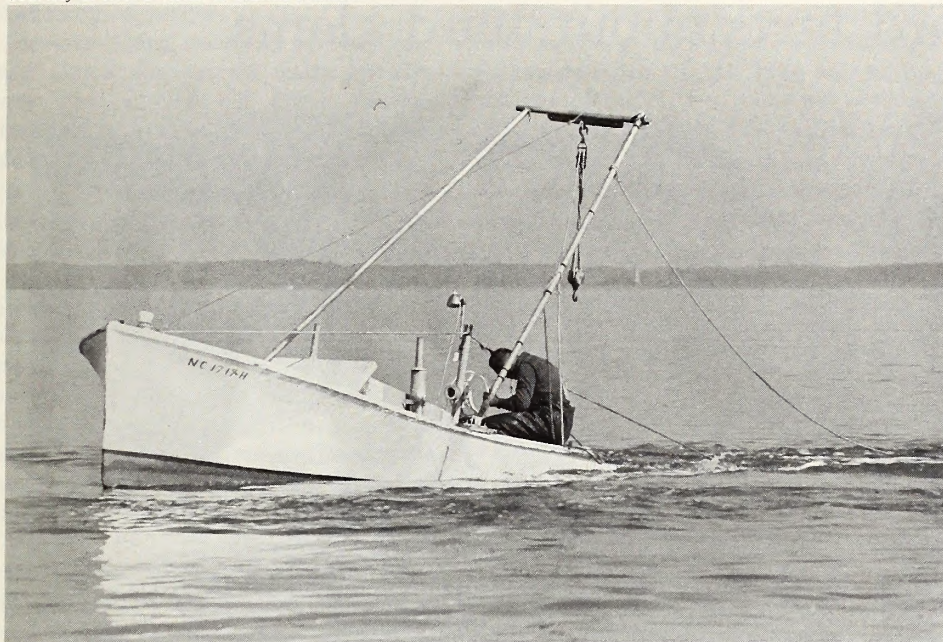
is no good anymore.

"I told my son it was wrong when he started kicking. But I know there's money in it. And what are you going to do when everybody else is out there doing it? But they're catching less and less every year. Before long they're going to reach a point where their expenses overpower what they make."

Many a temper has flared and a heated argument ensued over clamming in Carteret County. Traditionally, most clams harvested from North Carolina sounds were raked. But the invention in the mid-1970s of the kicker plate, an inexpensive metal plate welded to the rudder of the boat, changed the complexity of the fishery.

Clam kicking works this way: The





*A kicker stirs the water for an early catch*

kicker plate deflects the prop wash from the rudder to the bottom, where it furrows a path eight to 12 inches wide. The wash has enough force to blow out shells, clams, grass—whatever is in its path. A heavy trawl or net is pulled behind the boat and hauled aboard every 10 to 20 minutes to empty the net.

Only a few fishermen initially adopted the kicking methods, says Fentress "Red" Munden, shellfish coordinator for the state Division of Marine Fisheries. But a severe freeze during the winter of 1976-77 laid a thick layer of ice over northern clamming grounds and caused seafood dealers to look southward. Clam prices jumped and more fishermen turned to kicking, many trying to recoup losses from 1978's disastrous shrimp harvest.

Clam kicking is a more efficient means of harvest. An average kicker will net 20 to 25 bags of clams a day, while a hand raker will harvest five to six bags a day.

Initially there were few restrictions on clam kicking. Kickers could harvest clams year-round in any area they could reach that was not polluted. But a clamor quickly arose from fishermen, rakers and others concerned about the grass beds. Grass beds protect not only clams but other juvenile fishes, shrimp and other shellfish important to North Carolina commercial fisheries. Complaints poured into Marine Fisheries. Many fishermen

wanted the Division to put an end to clam kicking.

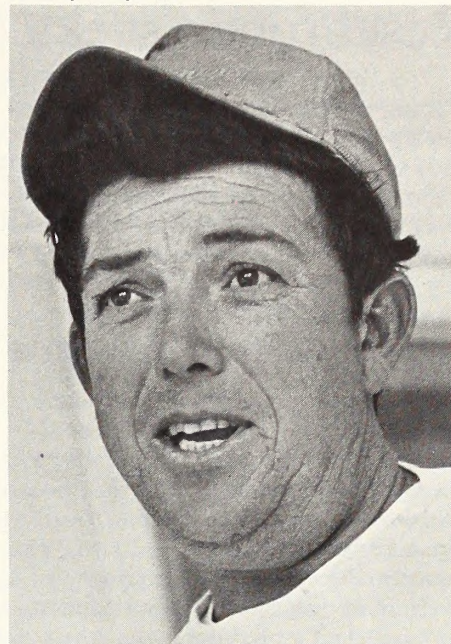
The Marine Fisheries Commission saw no need to end a valuable winter fishery, but it did begin imposing regulations in order to manage clam harvests. The commission limited mechanical harvesting to winter months, restricted kicking to daylight hours and certain days of the week, and set size limits.

Many clam kickers welcomed the restrictions. "We knew we needed a season," says Charles Gilgo. "Otherwise we would clean everything out in just a few years. We wanted to prolong the clams so we could continue to make a living."

In 1978 the Marine Fisheries Commission closed the grass beds to kicking. "I believed the grass beds should be set aside for the rakers," says Gilgo. "They're natural breeding grounds for shrimp and a lot of fish. And they're areas that shouldn't be kicked."

Today clam kicking is limited to Core Sound. Munden estimates about 200 boats were rigged to kick in Core Sound during the 1981-82 season. Harvest pressure has mounted, and fishermen like Charles Gilgo say things don't look good for the future.

"On a good day a few years ago I could bring home ten thousand to fourteen thousand clams a day," Gilgo says. "Now on a good day I may bring in seven thousand to eighty-five hundred clams. Prices have dropped too.



*Charles Gilgo*

Prices were sky high a few years back, but we've seen a decline over the past two years.

"I think Marine Fisheries should reseed places where we're kicking," Gilgo says. "It's the only way kickers like myself are going to keep going. Clams just can't reproduce fast enough naturally."

Seeding Core Sound with clams appears unlikely, Munden says. Experimental data indicate blue crabs would eat most of the seed clams in Core Sound.

Clam kickers also would like for Marine Fisheries to open up some new areas for kicking. But Munden says, "We feel all the area that can reasonably be opened has already been opened. To open other areas would damage grass beds, oyster rock or other fisheries."

"The fishery has reached the point where it is limiting itself. We could start a rotational system but it would involve the same area divided up into smaller portions. We're just not going to open any virgin area. The fishermen have backed themselves and us in a corner. There's so much pressure on the resource in this case I don't feel the resource can stand it much longer."

Whatever management system the Division of Marine Fisheries chooses for the future, it's sure to need some solid scientific data about clam biology and harvest methods to be successful.

—Kathy Hart



# Researcher seeks hard facts about hard clams

Charles Peterson may look like a man after his own dinner as he sifts the sands of Bogue Sound for clams. But he's not. Peterson, a biologist at the UNC Institute of Marine Sciences at Morehead City, is after some hard facts about hard clams.

As part of a UNC Sea Grant project, Peterson is looking into hard clam biology as well as the effects of different harvesting methods on clam populations and on the estuarine environment. The information he collects is being funneled into the Division of Marine Fisheries for use in future clam-management plans.

One of Peterson's early findings uncovers more information about one of the hard clam's predators, the whelk, often referred to as a conch in North Carolina. Peterson knew the hard clam was one of the whelk's favorite meals, but he wasn't sure how factors like seagrass cover and clam size and density affected the whelk's appetite.

The whelk and the clam seem like unlikely enemies since they're both encompassed by a hard shell. But Peterson says, "The whelk grabs the clam with his foot and rubs the sharp edge of his shell against the clam, chipping away at the margin. Eventually the whelk chips away enough shell to get his lip in and pry open the shell." Peterson says the whelk leaves the evidence behind—an empty, rasped shell.

To see how grass cover affects whelk predation, Peterson and a group of graduate students, headed by Hal Summerson, set out for Bogue Sound to set up sample plots. Some of the one-meter-square plots were denuded of their grass, while others were left natural. Peterson then set out clams, marked by a dot of paint, in each plot and left them for several months.

In the first experiment (October-May), Peterson found that along sandy bottoms with no grass coverage, 54 percent of the hard clams were rasped and eaten by whelks. In a second experiment (July-November), 84 percent of the clams were eaten by whelks. Predation rates were higher for the second experiment because of increased whelk activity during warmer months, Peterson says. Meanwhile, the clams tucked away in grass beds suffered little predation.

Peterson also learned that density or

Photo by Kathy Hart



*To tell a clam's age, Peterson halves the shell with this tool*

the number of clams per area did not affect the rate the clams were eaten by whelks. But the size of the clam did play a role in whelk predation along sandy bottoms. Whelks tend to choose larger over smaller clams to munch on. "It may be the whelk is looking for more return for his effort when he chooses the larger clams to eat," Peterson says. "We don't know for sure. But the data show clams can't outgrow whelk predation the way they can with blue crabs."

Peterson feels that his findings again point to the importance of seagrass beds, this time as a refuge for clams. He theorizes that seagrass roots and rhizomes compact the sediment around the clam, making it harder for the whelk to dig out his prey. Or the root material itself may deter the whelk, Peterson says.

As another part of his study, Peterson has been learning how to determine a clam's life history by reading the lines in his shell. The clam, like a tree, lays down an annual line that reveals its age. Scientists knew clams in northern waters added a growth line during winter months when they exhibited little or no growth. But Peterson knew North Carolina winters weren't cold enough to halt clam growth. Maybe southern clams didn't tell their age so easily.

But they did. Peterson found that most North Carolina clams add a growth line during the late summer or early fall. The clams growth rate slows 50 percent, causing the clam to add a growth line, Peterson says. He suspects the line is added during a period of physiological difference that may have some connection with the re-



productive sequence.

Besides laying down an annual line, hard clams also record daily growth lines and events in their shells. "Reading the days in a clam shell is like looking into a crystal ball," Peterson says. "You can see events like storms or lunar tides recorded right in the shell."

In Core Sound Peterson found that most hard clams reach legal harvest size (one inch thick) in one-and-a-half years. "But interestingly the clams that have reached harvest size have only had one reproductive season," Peterson says. This means that the clams have reproduced very few, if any, baby clams, he says.

Peterson found the average age of clams in Core Sound to be nine years. Ages among clams in the sample ran from less than one year to the ripe old age of 32.

But the clams' long life spans worry researchers like Peterson and also resource managers at the Division of Marine Fisheries. A long-lived species generally show lower levels of reproduction than annual species like shrimp and scallops. This could mean today's large harvests are feeding off of several years of reproduction that cannot be matched annually.

"It has really become imperative," Peterson says, "to address whether we need to worry about managing the stocks and whether we will be able to continue the level of harvest we are currently applying to the population."

In another part of Peterson's project, he and his graduate students compared the harvest efficiency and environmental impact of two hand-operated clam rakes—the pea digger and the bull rake. The pea digger, traditional gear used by hand rakers in North Carolina, resembles a garden rake, having a wooden shaft leading to a steel head with three to six prongs. Rakers pull the pea digger back and forth along the bottom waiting to hear the scaping noise of metal hitting shell, signaling a catch.

The bull rake has only recently made its debut in North Carolina after being used in the Long Island Sound. Its main feature, a cast iron basket, attaches to a metal shaft which ends in a T-shaped handle. Fishermen push the teeth of the basket about 5½ inches into the sediment and then pull the rake in short, quick jerks. As it is pulled along, clams, shells, seagrass

and other debris are forced into the basket. When the basket feels full, the fisherman pulls up the rake and sorts out the clams.

Peterson tested the two rakes on a sandy bottom. The pea digger dug up more large clams than did the bull rake. And with a pea digger, researchers were able to cover more area than with the bull rake.

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*"Reading the days in a clam shell is like looking into a crystal ball."*

*—Charles Peterson*

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In the seagrass bed the opposite occurred. The bull rake captured more clams and covered more area than the pea digger. But the problem comes in the amount of seagrass removed by each rake. The bull rake removed, on the average, more than twice as much seagrass as the pea digger. It also had a greater effect on roots and rhizomes, important sources of seagrass survival and reproduction.

Peterson says his findings will support Marine Fisheries' restrictions on the use of bull rakes in seagrass beds, restrictions that have been under fire.

Of particular interest to the Division of Marine Fisheries, says Munden, has been Peterson's work with clam kicking. Kickers have long claimed that kicking cultivates the bottom, making better conditions for next year's baby clams and increasing their numbers.

But in an experiment where Peterson kicked and raked experimental plots then compared them to areas left untouched, he found no increase or

decrease in baby clams. Even areas kicked for two years showed no increase in baby clam populations.

As another part of the kicking experiment, Peterson tested the recovery rates of seagrass from raking and kicking in seagrass beds. After raking and kicking his experimental plots, Peterson waited a few months to see how the grass fared. He found that the more in-

tense the harvest (medium and high kicking levels) the greater the damage to the grass beds. Grass coverage was cut to about half of the before-kicking levels in the medium- and high-kicking plots.

After 10 months Peterson sampled the grass beds again. Grass coverage in the raked and low-kicking plots had recovered, but the medium- and high-kicking plots showed no tendency toward seagrass recovery.

Munden says Peterson's information provides important scientific proof of the long-lasting effects of clam kicking in seagrass beds.

While Peterson has gathered a lot of information about hard clams and the methods used to harvest them, he has more work to do. He plans to measure the effect of clam kicking on the survival of benthic invertebrates (food for fishes) and on the turbidity of the water. Peterson plans to compile his information into proposed management guidelines for the future.

*—Kathy Hart*

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## To hatch a million eggs

A metal shed perches by the edge of Core Sound in Atlantic. It might hold fishing gear. But it doesn't. Eight million baby clams are calling that shed home until May.

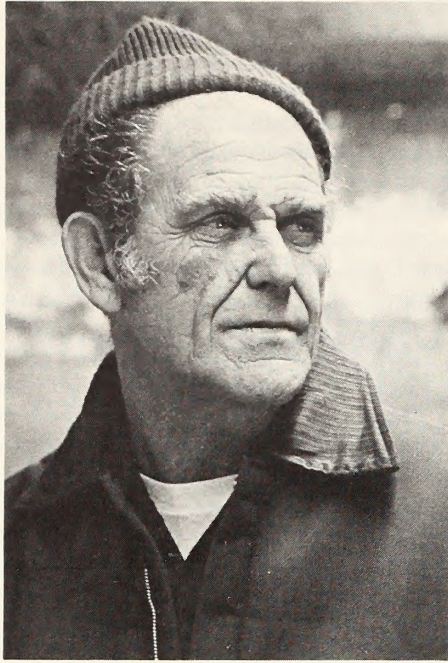
Monroe Willis, a native of Atlantic, and his partner, Earl Huskey of New Jersey, are gearing up what they hope will be a lucrative business—a clam hatchery. Clam hatcheries are new to North Carolina. Most clam culture has previously taken place in New England and Long Island. But warmer waters and longer growing seasons

mean a marketable clam in fewer years in the southeast. Add the shorter growth period to the rising prices clams bring from seafood dealers and it equals more people interested in growing their own clams.

But it takes more than interest to get you started in clam culture. It takes some knowledge of clam biology, money to invest in equipment and lots of patience, says Tony Capehart, a Swansboro ice dealer. After reading up on clam culture literature and talking

*Continued on next page*





Monroe Willis

to others in the state who were experimenting with hatcheries, Capehart decided to set up a small hatchery of his own.

"As soon as I heard about the idea of clam hatcheries I told myself I had to try it," the young Capehart says. "You've got to be innovative if you're going to stay ahead these days."

Capehart describes his methods for culturing clams as one of "trial and error." First he collects a breeding stock of clams that are a moderate size and are not blunted or deformed. Capehart places the clams in a tank.

"I take a few sample clams, bust them open and check their gonads to see if they're ready for spawning around the end of April or the first of May," Capehart says. "If they're ready we quickly raise the temperature in the tank to 78 to 80 degrees to provide thermal shock."

Thermal shock may cause the clams to spawn. But usually Capehart drops an eyedropper full of milky sperm (taken from the test clams) into the tank. The sperm, as it is drawn through the clams' systems by their pumping action, should induce the male clams to cast their sperm and the females their eggs. But what they should do and what actually happens may not be the same, Capehart says.

"Sometimes after I drop the sperm in the tank the clams quit pumping," Capehart says. "Sometimes they take it in and don't spawn and sometimes



Water pours into clam trays

they just spit it right back out. It's frustrating. They don't spawn on every attempt. I may sit with 'em all day and they'll never spawn."

But if successful, Capehart may end up with several million fertilized eggs. After collecting the eggs, he takes a one-milliliter sample and examines it under a microscope to determine how many eggs he has. The number of eggs in the sample will establish the amount of water and algae the clams will need to survive and grow. Capehart feeds the clams algae cultured in glass bottles for about the first week or so of their existence.

"It's like feeding 'em Wheaties," Capehart says. "They grow much faster and they get a better start."

The clams hatch within two days and enter a larval stage. During this larval stage, Capehart sieves the clams through screens to separate the larger larvae from the smaller larvae.

In eight to 14 days the larval clams are ready to set or drop from the water column to the bottom. A larval clam preparing to set has a tiny shell and muscular foot which attaches the clam to a surface. Capehart places the setting clams in wooden trays, called raceways, fed by brackish water pumped from the White Oak River. The clams now feed off the nutrients found in the raw seawater.

Of the several million fertilized eggs Capehart begins with, only about five to 10 percent survive to be placed in

the raceways. Sorting, disease and other hazards claim many of the larval clams.

The baby clams nurture in the raceways until January or February, eight to nine months, before Capehart plants the clams on leased bottom nearby. Capehart prepares his leased area by making a bed for the clams out of scallop shells. After laying the clams on their bed, Capehart tucks them in by staking nets over the bed to ward off predators like crabs, whelks, rays and starfish.

After a year in their bed, Capehart checked his first crop of clams to determine their progress and the results show in his face. "I was really happy with what I found," he says. "The clams show good growth and not much predation. I really feel encouraged again."

While Capehart's clams snuggle among the scallop shells in the White Oak River, Monroe Willis' and Earl Huskey's clams still lie in their cement-block raceways in Atlantic. Huskey and Willis, in their first year of operation, are waiting for spring to plant their clams.

Willis squats by the edge of one of the raceways and scoops his hand through the silt that has settled there. As the feathery silt sifts away, a mound of  $\frac{3}{8}$ - to  $\frac{1}{2}$ -inch clams appears. "We're going to hold 'em in the raceways here until next year's crop start setting, about May," Willis says. "We figure the larger they are when we put 'em on the lease the less likely they'll be eaten by crabs. Crabs don't bother 'em much once the clams get some size on 'em. We've had a few crabs get through our water filtering system and before you know it they'll have a big pile of empty shells over in one of the raceways."

From crab predation to disease problems, the fisherman starting a clam hatchery faces a lot of unknowns. But straighten out a couple of the mechanical kinks, add a little more science, and clam culture operations like Capehart's and Willis' may offer up more clams for our tables in the future than are fished from the wild.

(For more information about clam hatcheries and clam gardening, contact John Foster of UNC Sea Grant. Foster works with the Aquaculture Demonstration Project in Aurora and can be reached by calling (919) 322-4054).



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



**Seafood.** It's high in protein and low in calories, but many North Carolinians shy away from cooking seafood at home. Nadine Tope, a food and nutrition specialist with the N.C. Agricultural Extension Service, is trying to teach more people about the value and ease of cooking seafood.

Tope, Joyce Taylor of the NCSU Seafood Laboratory in Morehead City, Hilda Livingstone of the N.C. Marine Resources Center on Roanoke Island, and Hallie Hooper, Maureen Rickards and Joy Frauson, home economics agents in Dare, Carteret and New Hanover counties, respectively, are putting together a slide show funded by a UNC Sea Grant mini-grant. The slide show will demonstrate methods for preparing and storing seafood, introduce unusual species to homemakers and stress the nutritional value of seafood.

The slides will be used in county extension demonstrations and also in seafood demonstrations at the N.C. Marine Resources Centers and at the NCSU Seafood Laboratory.

Another Sea Grant mini-grant will focus on peeler crabs—crabs about to shed their shells. Rhett White, director of the Marine Resources Center at Roanoke Island, and Hughes Tillett, Sea Grant's marine advisory services agent in that area, have received funds to set up a permanent peeler crab demonstration.

The exhibit will be built near the center, and will include two crab-

shedders and panels describing the shedding process. The exhibit, which will be built this spring, will be used by Sea Grant and Marine Resources Center staff for demonstrations and educational lectures.



The beach environment can be hostile to plants. Not every species can tolerate sand, salt spray, intense heat and harsh winds. And, those species that can survive these elements require careful planting and maintenance.

*Seacoast Plants of the Carolinas for Conservation and Beautification* is a handbook for coastal property owners interested in using plants for landscaping and protection. Written by Karl Graetz, a retired Soil Conservation Service agent, it provides descriptive information and photography on each plant species in addition to tips on planting and propagation.

To obtain a copy of this 206-page handbook, write Sea Grant, Box 5001, Raleigh, N.C. 27650-5001. Request publication number UNC-SG-73-06. The cost is \$2.00.



Women have traditionally been an important force in the North Carolina seafood industry. Often they head shrimp, shuck scallops, pick crabs and manage the family seafood business while the men are out fishing.

But female commercial fishermen are rare. The clamming fishery in Carteret County is an exception.

While doing an analysis of clam licenses for a Sea Grant project, Marcus Hepburn discovered that a significant percentage of the clambers in the county were women. Hepburn, an anthropologist with the Institute for Coastal and Marine Resources at East Carolina Univer-

sity, says a breakdown of 2,100 licensed clambers averaged one female to every five-and-a-half males. On Harkers Island, one out of every three clambers is female.

"The opportunity for women is definitely there," Hepburn says. "Clamming provides an easy source of income because you don't need a boat or a lot of gear." Hepburn found that 95 percent of the female clambers work in the warmer months, either raking or swimming for clams. Many women occasionally accompany their husbands who go out clamming, too.

But, the significant percentage of women clambers comes as no surprise to Hepburn. "The participation of women in the clam fishery," he says, "has always been higher than the other fisheries, fifty years ago and today."



*Socioeconomic Aspects of the Bay Scallop Fishery in Carteret County, North Carolina*, by Peter H. Fricke of the Institute for Coastal and Marine

Resources at East Carolina University, takes a look at fishing communities along Bogue and Core Sounds and their dependence on the bay scallop fishery.

For a copy of the report, write UNC Sea Grant, P.O. Box 5001, Raleigh, N.C. 27650-5001. Ask for publication number UNC-SG-WP-81-12. The cost is \$1.25.

*The Variability of Sea Level in the Carolina Capes*, by Leonard J. Pietrafesa, Shenn-Yu Chao and Gerald S. Janowitz of the Department of Marine, Earth and Atmospheric Sciences at North Carolina State University, is the study of coastal sea level and its relationship to atmospheric forcing along the Carolina Capes.

To receive a copy of this report, write UNC Sea Grant. Ask for publication number UNC-SG-WP-81-11. The cost is \$1.75.

*Continued on next page*



*Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina*, by Preston P. Pate of the N.C. Office of Coastal Management and Robert Jones of the N.C. Division of Marine Fisheries, reports the efforts of a Sea Grant study designed to measure the effects of freshwater drainage on primary nursery areas of the northern Pamlico Sound.

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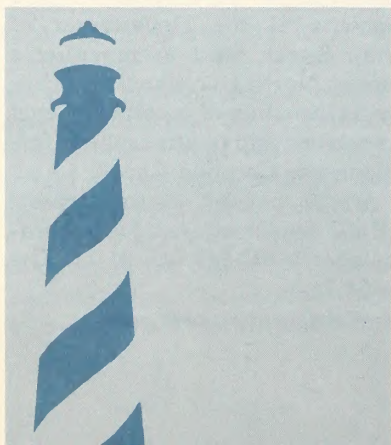
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## COASTWATCH

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# COAST WATCH

## Scallops

*The luxury seafood. Scarce, and so rich in flavor, it even tastes expensive.*

*In the past, scallops have held a distinguished but modest place in the bottom half of fisheries-landings lists. Bay scallops were few and seasonal. Sea scallops and calicoes appeared and disappeared with mysterious irregularity. Processors handled what few scallops they got with some of the same laborious methods they had been using for generations.*

*In 1980, things changed. The East Coast fishery landed \$10 million worth of scallops. In 1981, that figure rose to \$40 million. Word is out that the industry may triple those dollars in 1982.*

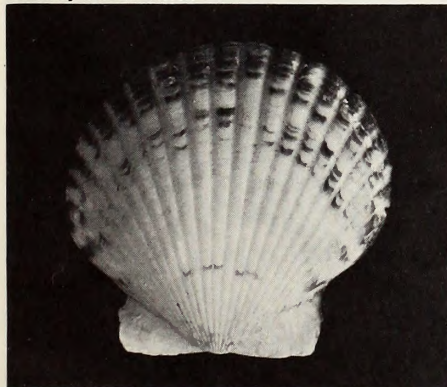
*There were several reasons for the boom: Opportunistic fishermen, often from North Carolina, were using big, steel-hulled boats with increasing skill. New machines multiplied the*

*Continued on next page*

Photo by Neil Caudle



Photo by Steven Wilson



The calico scallop

A hopper of calicoes heading for the steam box



processors' output. And, an aggressive entrepreneur, retired from the North Carolina pulpwood industry, made inroads into the world scallop market.

But the main reason was the calico scallop itself. Prolific and fast-growing, the calico can grow to commercial size in six months. It spawns year-round, and in-

dividual calicoes can release more than a million eggs and 25 billion sperm cells in one spawn. It matures and dies in about two years, sometimes disappearing almost overnight. Its limits are still unknown.

So when the calico showed up in force off Florida last year, the seafood industry mobilized like

never before. Fishermen hustled to catch as many loads as they could before the scallops disappeared or died. Even an unpleasant bout with parasitic nematodes failed to spoil the fun.

This month, Coastwatch looks at the calico scallop fishery, and some of the North Carolinians who have helped to build it.

## Machines haven't quite replaced hand-shuckers

In a back room at Homer Smith Seafood in Salter Path, Hancy Marshall shucks scallops by hand, turning out about five gallons of the sweet-tasting mollusks a day. But in the front room of the processing plant, things are mechanized. Scallops ride conveyor belts from steam box to packing table. Depending on the size, 150 to 500 gallons of scallop meats may roll off the conveyor belt each day.

Homer Smith Seafood contrasts the old and the new. The old, hand shucking has been around for years. Marshall says she's shucked scallops since she was 15 years old—some 37 years. Today she's turning out bay scallops her son harvested along the North Carolina coast.

Marshall stands by a concrete tray and plucks a bay scallop from a massive pile of the bivalve mollusks heaped there. With a scallop cupped in her left hand, Marshall pries open the shell with a quick twist of her knife. Discarding the top shell, Marshall scoops the viscera out of the bottom shell and scrapes the adductor muscle, the part that is eaten, into a paper cup. As the paper cup fills, she empties it into a plastic gallon bucket.

Marshall says she learned to shuck scallops by watching others. She shucks scallops from December through May. During the summer Marshall works in Homer Smith's fish market.

According to John Maiolo, an East Carolina University sociologist and UNC Sea Grant researcher, most of North Carolina's hand shuckers are women. For many, shucking supplements their families' incomes.

Hand shuckers usually combine shucking with other seasonal processing activities such as heading shrimp,

picking crabs, filleting fish and shucking oysters and clams. A fast hand shucker can earn \$50 a day. An average shucker will earn about \$1000 a season, Maiolo says.

Today most hand shuckers turn out only bay scallops harvested from North Carolina estuaries. Mike Fiorini of Homer Smith Seafood says processors don't run the bay scallops on the machines because the freshly caught bays don't open as readily as calicoes in the steam box. Processors retrieve more meat if the scallops are hand shucked.

Also fishermen prefer that their bay scallops are hand shucked, Fiorini says. The machines are not 100 percent efficient, so some of the meat is lost. For a fisherman being paid per gallon shucked, every piece of meat means

more money in his pocket.

While the hand shucker may be efficient, you can't beat the mechanical shucking machines when it comes to processing the thousands of pounds of calicoes trucked into Carteret County each day. The mechanical shucking machine has been around for almost 30 years, Maiolo says. Elmer Willis claimed to have developed the first mechanical shucker in Carteret County. Willis received the first patent on the machine, but others contested his claim to the invention.

Sam Thomas, Sea Grant's seafood specialist with the NCSU Seafood Laboratory in Morehead City, says mechanical shucking equipment was a combination and adaptation of machines already in use in food technology. The eviscerator, for exam-

Photo by Neil Caudle



Hancy Marshall shucks bay scallops by hand





*Hand-sorting calicoes*



*Weighing scallops at the packing table*

ple, was an adaptation of a machine used to stem cherries.

The mechanical shuckers have been used sparingly since their invention. Mechanical shuckers saw some use during the boom of calico scallops off the North Carolina coast in the late 1960s. And some sea scallops were processed on the mechanical shuckers, but Thomas says many of the shucking machines lay idle during the 1970s.

Idleness isn't a problem today. North Carolina processors are cashing in on the calico lode in Florida just as fast as their trucks can deliver. With equipment already in place, this state's processors were able to jump in on the scallop market quickly, once they saw the profits were substantial and steady. After North Carolina processors entered the market in 1981, they shucked almost half of the \$40 million of calicoes processed in the U.S.

Six or more scallop-shucking plants are operating in North Carolina now. Technology is advancing rapidly as processors work constantly to improve their equipment. Much of the shucking equipment is built in local shops since there is no manufacturer of scallop-shucking equipment. A new eviscerator may cost a processor \$20,000 to \$25,000.

Thomas says there are added costs to processing the calicoes in North

Carolina. Processors here must pay freight costs from Florida and larger ice bills to keep the scallops cold along the way. "With North Carolina processors, the yield per load of scallops is more critical because processors must pay some added costs before they make a profit," Thomas says.

Fiorini says it takes the tractor-trailer trucks about 12 hours to make the trip from Cape Canaveral to Carteret County. The calicoes are iced before they leave Canaveral and, during warmer months, may be iced again along the way. As soon as the trucks arrive at Homer Smith Seafood, the ice is washed out and the truck backed up to the off-loading ramp, Fiorini says. A front-end loader scoops up calicoes and dumps them into the hopper.

"They go up a conveyor belt to a shell-trash separator," he says. "It takes the trash fish and broken shell out. And then the scallops leave there and go into a steam tank. We have a boiler and about fifty pounds of pressure. And we have steam pipes; I think we have eight of 'em in there. The steam sprays on the scallops and that causes their mouths to open."

After leaving the steam tank, the calicoes fall onto a large pan that shakes the meat from the shell. From the shaker the scallops go through a de-sheller, which removes the smaller

pieces of shell that slipped through the shaker. When the scallops fall onto the eviscerator, a series of rubber-coated rollers pinch the loose viscera away from the meat of the adductor muscle.

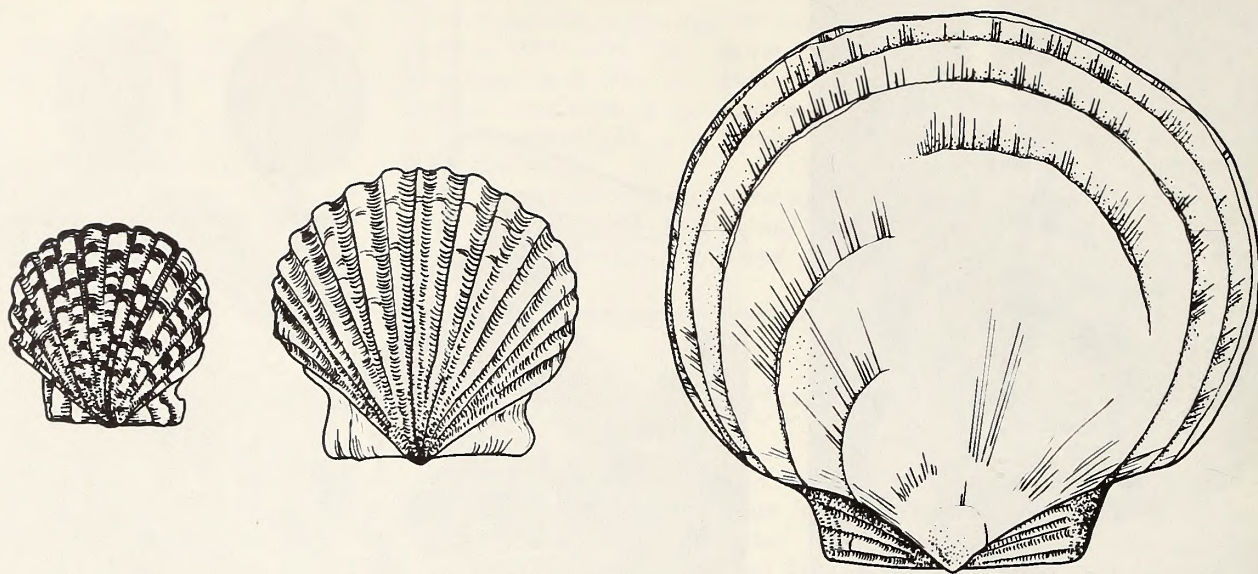
The scallops, looking more like the food we know, now roll down a wide conveyor belt used as the picking table. About four people, usually women, stand on either side of the conveyor picking out scallops not completely cleaned by the eviscerator. Unclean scallops are whisked back to the eviscerator for another try. Clean scallops roll on to the packing table where they're weighed and packed in gallon tubs.

Fiorini says most of Homer Smith's scallops are shipped to New Jersey, New York and Boston, while a few are sold to state retail markets. Most North Carolina processors ship their calicoes to northern seafood markets. Currently, they are getting a price of about \$21 a gallon.

Which tastes better, the bay scallop or the calico? Unless you have the most discriminating taste, you probably can't tell the difference, seafood experts say. "There's definitely a southern preference for the smaller, sweeter bays and calicoes over the sea scallop," says Maiolo.

—Kathy Hart





The calico, bay and Atlantic deep-sea scallop, drawn about half their adult sizes

## When the Carolina crews blow in, watch out

If there's a bonanza in fishing along the East and Gulf coasts, whether it be in scallops, shrimp or fish, then you can bet your last dollar that North Carolina fishermen are there. Characterized as opportunists, they seem always to be aboard when the ship comes in.

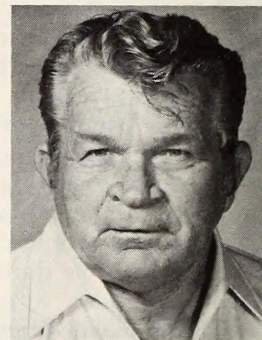
But to be an opportunist in the fishing industry you have to be good at what you do and versatile at the same time. "They're always a force," says John Maiolo. "Whenever something happens the North Carolinians get in there and they seem to outfish everybody. They fish the pants off people. They work harder. The labor is a little bit less expensive. They make more sacrifices.

"And they're so flexible. They say OK, New Bedford is down, shrimp aren't so hot, so let's go knock the hell out of calicoes in Florida. They're remarkable. These are the guys willing to live on their boats, not in fancy motels. They're willing to defer a lot of gratifications. They're hard-working, honkey-tonk-loving sons-of-guns. And they're really neat people."

Today the bonanza is calico scallops and North Carolina fishermen have swarmed the Cape Canaveral docks, making up about half of the 100-plus boats in the Florida scallop fleet. But not so long ago it was the New

*"I watched sea scallops go from a bonanza to an empty shell. By the time we left it wasn't worthwhile to be there."*

—Ron Tillett



England sea scallop they were after.

Fishing the waters off the Georges Bank, Tar Heel fishermen stocked their boats with sea scallops and returned home to sell them to North Carolina processors. As stocks declined, New England fishermen became more and more angry about the intrusion from their southern counterparts. New Englanders began clamoring to their fishery management council to regulate the fishery. They wanted a 30-meat-count (30 meats per pound) limit set for the sea scallops.

North Carolina fishermen felt the lower meat count favored the New Englanders' dredge/shuck-at-sea fishing methods. They turned to the South Atlantic Fisheries Management Council for help. In a study funded by

UNC Sea Grant, Maiolo found that many smaller boats from this state and most of the shoreside personnel (hand shuckers) would be pushed out of the industry if the 30-meat count were adopted.

But while the councils haggled over the management of the fishery, sea scallop stocks continued to dwindle. "I watched them (sea scallops) go from a bonanza to an empty shell," says Ron Tillett, a Wanchese fisherman. "By the time we left it wasn't worthwhile to be there."

As North Carolina fishermen hit a dead end with sea scallops, news of large calico beds in Florida began to filter back to North Carolina.

"We kept hearing little pieces of information about these scallop beds in



Florida, so I decided to go down and take a look for myself," Tillet says. "It didn't take me long to figure out what was going on."

Tillet quickly moved his three 85-foot, steel-hulled boats from Wanchese to the Canaveral docks in September 1981. "The first three months we were there, we were making big money," he says. "But like every good thing, it comes to an end, and now things are starting to dry up." Tillet says that initially fishermen working his boats at Canaveral were earning \$1,200 to \$1,500 a week, while now they earn \$300 to \$400.

Each boat carries a four-man crew. Originally all of Tillet's crewmen were from North Carolina, but a few tired of being away from home, he says. Each crewman makes four to five trips a week, working continuously from the first trip to the last with crewmen spelling each other for meals and rest during the five- to six-day period.

A boat geared for scalloping looks much like a shrimp trawler. It pulls two heavy twine nets, heavier than those used for shrimping because of the increased weight and sharp shells of the calicoes. Scallop boats also pull a heavier tickle chain (the chain which precedes the net and "tickles" the catch off the ocean floor) because they must dig deeper into the muddy bottom to stir up the calicoes.

Tillet says he usually harvests 25 to 30 bushels of calicoes per net for each 10- to 20-minute tow. Over a single trip to the calico beds, lasting about 24 hours, one of Tillet's boats will bring in two tractor-trailer loads of scallops, taking three hours to unload from the boat. Like other North Carolina fishermen in the Canaveral fleet, Tillet sells his scallops to North Carolina seafood processors, who truck them home for processing.

Tillet is paid according to how many gallons of meat his catch yields. During late March, he was collecting eight dollars a gallon from the processors, an increase of one dollar a gallon from the previous month. During winter months, scallops get watery and the meat content drops, much the same as oysters do in North Carolina during the summer, when they are spawning. Biologists believe calico scallops spawn during the winter. Tillet says his yield per catch decreased during the winter, but is on the rise again now.

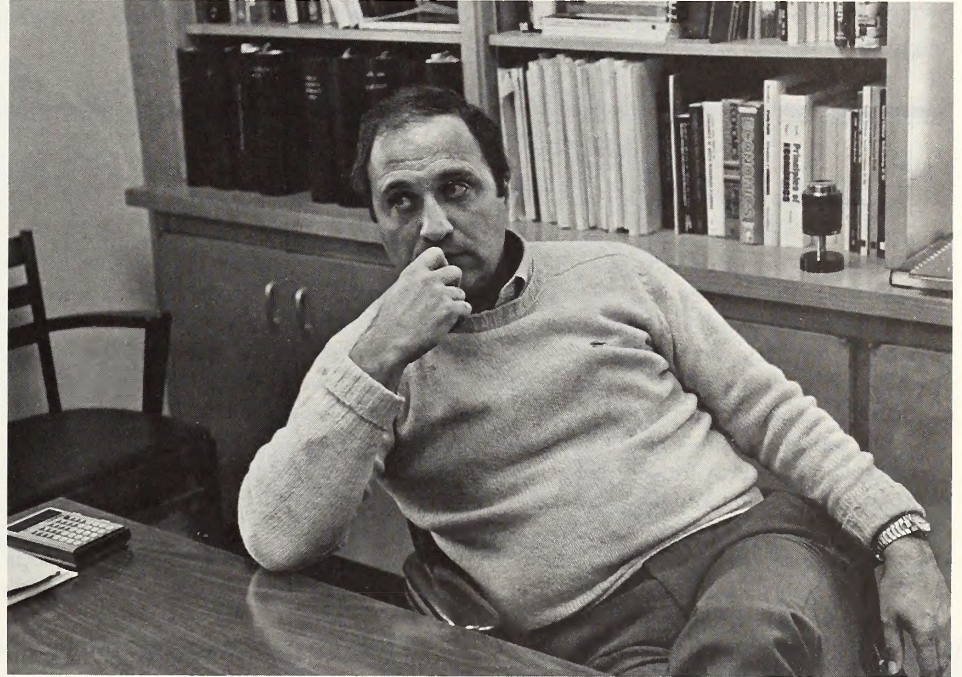
Another reason for smaller yields during the past winter came when fishermen had to move from the larger, older beds of calicoes to the smaller, younger beds because of nematodes. "The Florida Department of Agriculture came in and started checking our catches," Tillet says. "It really slowed things down for a while.

They showed the fishermen what the nematodes looked like so when my men went out, they could make a short tow of a bed, open up a few of the scallops and decide if the beds were infested. What we finally settled on were the small, young beds of calicoes."

But what worries Tillet and others

*Continued on next page*

*Photo by Neil Caudle*



*John Maiolo*



*Crew sorts sea scallops for on-board shucking off New England*



about dipping into the younger beds is the waste of tomorrow's catch. Many small scallops from each haul, too small to process, go to the dump after being sorted from the catch that is trucked to North Carolina or processed in Florida. "Since Christmas we have been bringing in today's catch and throwing out tomorrow's," says Ronald Earl Mason, Carteret County seafood processor and boat owner. "That's one thing that offends me right now is that we should be leaving

those small scallops at sea."

Mason, whose 88-foot steel-hulled boat, the *Carteret Pride*, is fishing the Canaveral waters now, says he would like to outfit his boat to prevent the waste. He wants to install an on-board separator to cull out the smaller scallops at sea, where they can be deposited alive back into the ocean. Mason would also like to devise a way to store the scallops in his boat's refrigerated hold so the boat could make longer trips.

But Tillett feels the boom of calicoes is almost over. Already part of the fleet (about 17 boats) is planning to pull out to give sea scalloping a renewed try, he says. "I expect that we'll clean it up down here before the summer's over," Tillett says. "Things are going to happen the same way here they happened in New England. Mother Nature can make plenty of something but when enough of mankind is out there after it, they can wipe her out in no time."

—Kathy Hart

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## Nematodes threaten calico market, but not health

There are nematodes everywhere—in the soil, in the sea, in plants and animals, and in food. So nobody in the seafood industry was especially surprised when nematodes turned up in processed calico scallops this winter.

The telltale sign—a small, brown spot on the adductor muscle, where the parasite was encysted—was hard to detect. If there were nematodes visible, they were tiny and hairlike.

The affected scallops came from huge beds off Cape Canaveral. By mid-December, nematode levels were

that no more than 20 percent of the scallops in any one lot could be infested with nematodes. North Carolina officials seized several truckloads of scallops when higher numbers of parasites were found.

"It was a patrol-type activity," Sitko says. "There was no danger to health, but aesthetically the nematodes are objectionable in high levels. If you're paying for scallops, you should be getting a reasonably clean product."

Sitko says the 20-percent standard

a raw scallop, any nematodes in it would be killed almost immediately by your gastric juices. It is not a parasite to man and it could not live in the intestine."

Thomas points out that nematodes are not new to the seafood industry, and that they are getting more attention now because of the great increases in scallop production.

"In any kind of food product, you have defects of this kind," Thomas says. "The idea is to keep the defects to a minimum, for the sake of the consumer."

The South Atlantic Fisheries Management Council is considering a plan for managing the calico-scallop stocks. Proposed regulations would address the nematode problem and also attempt to decrease the harvests of juvenile calicoes, which have been taken in great numbers from the same beds as older, nematode-infested scallops.

Meanwhile, officials in Florida and North Carolina report that the trouble with parasites may have corrected itself. Since the crackdown this winter, they say, fishermen have been sampling beds first, then moving on if the parasites are there.

"We haven't had a call on this in about three or four weeks," Sitko says.

Thomas says that even though the nematodes problem seems to be under control, processors are afraid some inaccurate reports and misinformation have already cooled the public's love affair with the scallop.

"It would be a shame," he says, "if this took away from any of the joy people get from eating scallops."

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*"There was no danger to health, but aesthetically the nematodes are objectionable in high levels. If you're paying for scallops, you should be getting a reasonably clean product."*

—Daniel Sitko

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running so high that the Florida Department of Agriculture stepped in and began monitoring scallops as they landed at Canaveral. Some of the samples showed 60 out of every 100 scallops were infested. Several shipments were embargoed, and the state of Florida, which had an interest in the reputation of its product, asked the U.S. Food and Drug Administration (FDA) to help monitor shipments into North Carolina processing plants.

Daniel Sitko, supervisory investigator with the FDA office in Raleigh, says that his agency tested samples and advised North Carolina officials of infested calico shipments. The agency set a standard requiring

helped ensure a good product without imperiling the scallop fishery. He explains that many of the nematodes in scallops can be eliminated during routine processing. Setting a tougher standard would not necessarily have improved the quality, but it might have made fishing scallops too costly for fishermen to harvest, he says.

Sam Thomas, a Sea Grant seafood specialist at the North Carolina State University Seafood Laboratory in Morehead City, says that the nematodes are "totally harmless" as far as human health is concerned.

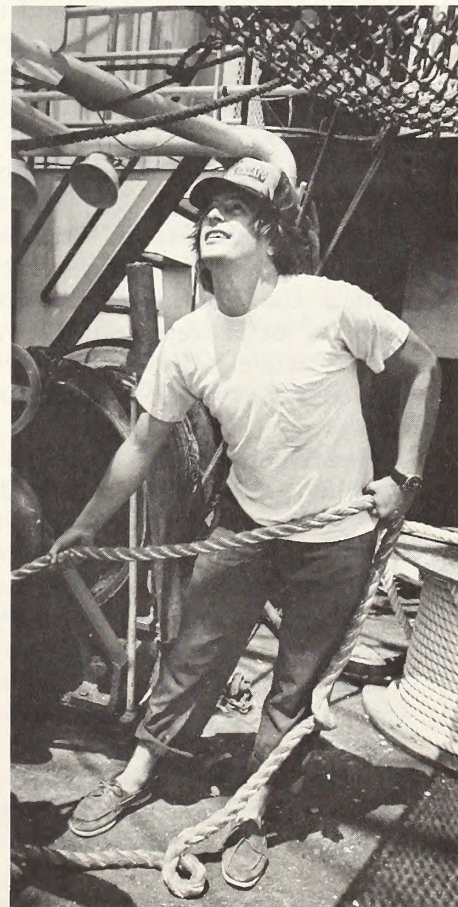
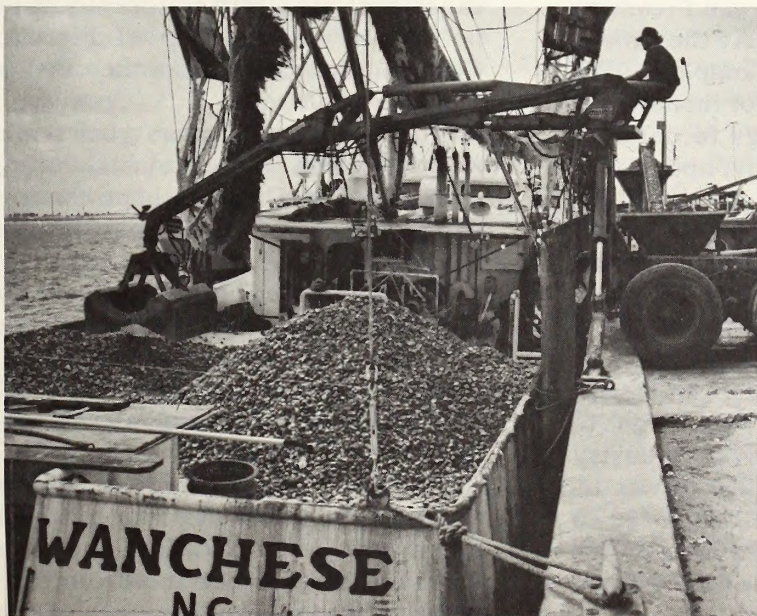
"These parasites are killed by low cooking temperatures, or by freezing," Thomas says. "Even if you consumed





## Working the Cape

*North Carolina boats crowd the docks at Cape Canaveral (above) while Kenny Brown (right) of Broad Creek hoists scallop nets aboard the Miss Sophie. Using a crane-like "cherry-picker," a worker scoops calicoes from the deck of a Wanchese boat (below).*





## Of lions, pulpwood And the scallop king

Stretched across the foreground in a borderless color photograph is the body of a large male lion. Its eyes are closed. Its head rests undisturbed between two paws, as if the King of the Forest were only sleeping.

But kneeling over the shape is William R. Lambert. His jaw juts, his smile is cocked and rakish as his hat. His right hand is gripping a gunstock.

If there exists another photograph of Bill Lambert, he won't admit it. He's a moving target, and he says photographers don't often get a clear shot at him.

He has sent the photograph along, though, because he hunts big game and shellfish for some of the same reasons. "I've got to have a challenge," he says. "I always have."

So Bill Lambert's story has a lion in it. It also has pulpwood, calico scallops and no small amount of controversy. The setting is first North Carolina, then Cape Canaveral, Florida, where NASA launches the space shuttle and Bill Lambert launches this story:

"Ten years ago, I didn't know a scallop when I saw one," he says. "I was in the lumber and pulpwood business in Greensboro, and coming down to Emerald Isle for vacations. At the time, I owned the Southern Pulpwood Company. We sawed a lot of trees and made a lot of money, but after a while I just ran out of things to do. So I retired at forty-two, sold the company, and moved on down to Emerald Isle."

Retirement didn't take, and Lambert began hanging around the docks and seafood plants on Bogue Banks. Nobody paid the outsider much mind when he came around to study a shucking machine or ask a few questions.

"After six months, I learned you just can't go sit down with a rod and reel," Lambert says. "I got to looking around and saw that the scallop industry then was in the dark ages. The machinery was no good, they were losing half of what they tried to shuck, and about twenty-five gallons a hour was the best they could do. Well sir, I was businessman enough to see a dollar sign."

Today, at 52, Lambert is being called the King of Scallops. His Southern Seafood Company is thought to be the largest producer of scallops in the world. Last year, Lambert sold a million gallons of scallops, about 7.2 million pounds. This year, he'll most likely sell more.

His shucking machines work around the clock, six days a week, each at a rate of about 200 gallons of scallops a day. His payroll carries 180 dockworkers and processors, and his contractors keep 30 boats and some 190 crewmen busy fishing, day and night. The crews hail from Florida, North and South Carolina and Georgia. Three of the boats are his own.

Since early last year, Lambert has been riding the crest of big landings from calico scallop beds off Cape Canaveral. His \$3 million processing plant at the Cape runs three complete sets of patented machines, designed and constructed in Lambert's own machine shop. If the Florida beds give out, Lambert's confident he'll find scallops elsewhere. Two mobile processing plants, built into tractor-trailer trucks, are ready to roll anywhere scallops are being landed.

From the first, Lambert saw that machines could make scalloping pay. He began with a small plant on the waterfront on Bogue Banks, tinkering with his equipment and hiring some old friends. Later he built newer, better machines into a plant near Cape Carteret. He operated two years there, until the calico beds off North Carolina quit producing, and he left to set up shop in Florida. The North Carolina plant now takes the overload his Florida plants can't handle.

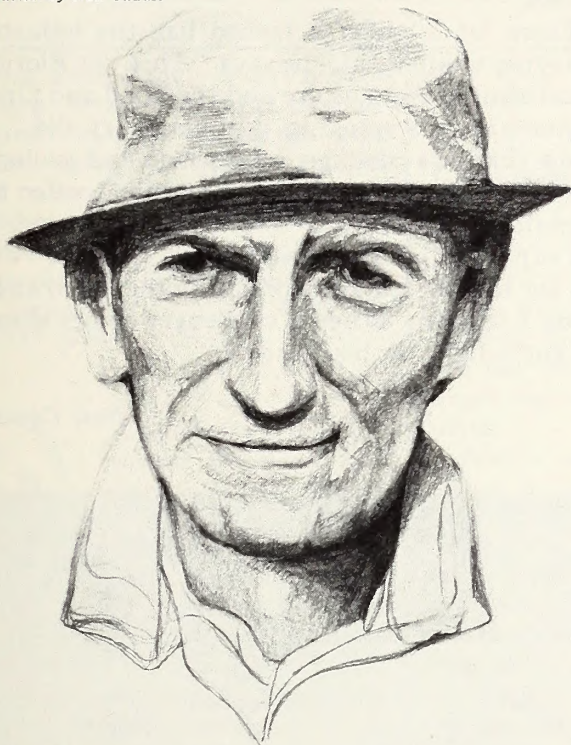
During a string of years when scalloping was off-and-on, others in the industry swung toward different quarry. Lambert kept chasing his scallops, paying bounties to East Coast fishermen willing to tip him off to new scallop beds.

"In the last eight years, I've only been out of scallops two months," he says. "I've kept looking for them, and I've found scallops where there wasn't supposed to be any."

When he found the scallops, his new-fangled gear could turn them out in a hurry. Before Lambert, unshucked scallops were hand-shoveled from the decks of fishing boats into bushel baskets, then winched slowly toward the dock. Lambert borrowed a crane-like tool from the pulpwood industry, fitted it with a scoop, and could soon make



Illustration by Neil Caudle



**Bill Lambert**

fast work of a loaded boat.

"I took that cherry-picker right out of the woods and adapted it for scallops," he says. "Now, you can unload in one hour what it took ten people to do in six or eight."

It was such efficiency, he says, that turned the scallop fishery around. Scalloping, once a sideline people took up when shrimping was down, became a year-round industry.

"In nineteen-seventy-three, this industry was worth sixteen-hundred dollars," Lambert says. "Last year it was worth around forty million."

His share of that figure? "Up until a year ago, we were probably about seventy percent of the American market," he says. "Now that all these new people are in it, we're probably not over thirty-five or forty percent."

But Lambert hasn't made all that money without also making enemies. Some accuse him of pushing the limits of legality, and rumors surface regularly that Bill Lambert is "being run out" of one place or another. North Carolina fishermen who don't work for Lambert complain that he has deliberately locked them out of prime docking space at Cape Canaveral. Floridians aren't happy

about the fact that Lambert's work force is mostly imported from the North Carolina pulpwood industry—some of Lambert's key people have been with him 25 years. And, competitors claim Lambert has been manipulating the market—flooding it with low-priced scallops to drive out rivals, then holding frozen scallops off the market to wait for higher prices. At least one new processing plant, owned by a Japanese firm, failed when it stood in against him.

"They lost over a million dollars and went bankrupt," Lambert says. "This is one time we outdid the Japanese."

He does have thousands of gallons of scallops waiting in the deepfreeze, but Lambert denies that he is out to force competition from the marketplace. "Really what I've done is open things up," he says. "Eight years ago, it was hard to sell a calico scallop because you couldn't supply them through the year. I've worked through several dry spells to keep them on the market, and I'm the only man who's stuck with it through the years, good times and bad. Now, I can take one machine and support a dozen boats a-catching. There are new processing plants all the time, where there used to be just a few. So how can you say I'm locking people out?"

Lambert blames political opposition to his operations for the legal troubles he's been having with the U. S. Army Corps of Engineers. At issue is Lambert's practice of piling empty scallop shells into hills around his plants. Others have done the same, but Lambert's plants have for years run into trouble over the question of waste disposal. Even in North Carolina, the issue helped nudge him off the waterfront and inland to the Cape Carteret site. There, he installed a machine to process wastewater as it left the plant.

In Florida, the Corps has determined that Lambert's shells are jeopardizing wetlands. Lambert says they don't, and the fight has taken him through a series of court battles.

Three times, judges have found in Lambert's favor, and each time the decision has been appealed.

"Every time they appeal it that way it costs me about fifty thousand dollars," Lambert says. "I've spent a quarter-of-a-million dollars on this fight."

Lambert takes umbrage at all this heat from the government, not only for business reasons, but be-

*Continued on next page*



cause he believes himself to be squarely on the side of the American Dream. He spurns imports and refuses to drive a Japanese car.

"I guarantee you we have cut scallop imports in half, and we're producing the best scallop in the world," he says. "Any time somebody can affect world markets, and help decrease the trade deficit, I'd say he's doing a little good for his country."

But however much he might like some regulations off his back, Lambert is at the same time looking for more government involvement in the scallop fishery. He wants the South Atlantic Fisheries Management Council to find a way to prevent a re-run of last year's problems with parasites and wasted juvenile scallops. And, he wants to see more university research into the calico scallop's behavior. He credits Steve Otwell, a Florida Sea Grant seafood specialist trained at NCSU, with helping steer fishermen out of parasite-infested

calico beds.

Nematodes did turn up last year in one of the shipments to Lambert's North Carolina plant. The staff then buried several hundred gallons of the affected shellfish, and Lambert's boats moved to new grounds.

"There for a while, it looked like the industry was trying to kill itself," he says. "Then the Florida Department of Agriculture and the Food and Drug Administration stepped in. I'm glad they did."

Now that he's conquered pulpwood and scallops, is he ready to move on? Lambert won't offer his competitors much hope.

"I expect to be here a while yet," he says. "I've been the biggest scallop producer in the world and I reckon I still am. When a challenger comes along, he's got a fight on his hands."

—Neil Caudle

## Recipes

If the price of scallops has kept them off your shopping list, try stretching them with fish flakes. The NCSU Seafood Lab and the Carteret County Nutrition Leaders have tested several new recipes using scallops and flaked finfish. (To learn how to make and use fish flakes, write for Sea Grant's brochure, "Fish Flakes: Seafood Stretchers." Ask for publication UNC-SG-79-01.)

Joyce Taylor, research technician at the lab, says the following recipes scored very high marks with the taste-test panel:

### Scallop Cakes/Stuffed Scallops

- |  |                         |
|--|-------------------------|
| 1 cup minced scallops                  | 1 small onion, minced   |
| 1 cup fish flakes                      | ¼ lb. margarine, melted |
| 2 cups bread crumbs                    | ½ tsp. parsley          |
| 2 eggs                                 | Pepper to taste         |
| 3 Tb. mayonnaise                       | Salt to taste           |
| 2 Tb. Worcestershire sauce             | ½-¾ cup fish broth      |
| Juice of ½ lemon with scraping of rind | Paprika                 |

Mix bread crumbs, eggs, mayonnaise, Worcestershire sauce, onion, lemon juice, margarine, parsley, salt and pepper. Add scallops and fish flakes to mixture. Use fish broth to adjust consistency. Shape into cakes and sprinkle with paprika. Bake in moderate oven, 350°F, for 20-30 minutes or until slightly browned.

Mixture may be stuffed into boiled and cleaned scallop shells and baked, as well as being made into cakes.

(Alternate cooking method for cakes: Place in skillet containing about ½ inch of fat, hot but not smoking. Fry at moderate heat. When brown on one side, turn and brown on other. Cooking time approximately six to eight minutes. Drain.)

### Scallops Baked in Shells

- |                         |                       |
|-------------------------|-----------------------|
| 1 lb. scallops          | ¼ tsp. sugar          |
| 1 lb. fish flakes       | 2 cups cracker crumbs |
| ¼ cup margarine, melted | Small onion rings     |
| ¼ cup catsup            | 1 Tb. butter, melted  |
| ½ tsp. salt             | Paprika               |
| Dash pepper             |                       |

Cut scallops into ¼-inch pieces. Combine margarine, catsup, salt, pepper, sugar, crumbs, scallops and fish flakes. Place in well-greased individual shells which have been cleaned and boiled. Combine butter and onion; place on top of each stuffed scallop. Bake in moderate oven, 350°F, for 25-30 minutes or until brown. Garnish with paprika.

### Deviled Scallops

- |                        |                             |
|------------------------|-----------------------------|
| 2 cups scallops        | 2 tsp. Worcestershire sauce |
| 2 cups fish flakes     | 2 tsp. lemon juice          |
| ½ cup butter           | 6 drops Tabasco sauce       |
| 1 Tb. prepared mustard | Saltine crackers            |
| 1 tsp. salt            | ¼ cup cracker crumbs        |

Chop scallops and heat. Drain off liquid. Mix scallops with fish flakes and put in baking dish. Beat softened butter, creaming in mustard, salt, Tabasco and Worcestershire sauce. Add to scallop-fish flake mixture. Cover with layer of crackers, then sprinkle with cracker crumbs. Bake in moderate oven, 350°F, for 20-30 minutes or until browned.



# THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).



Aquaculture, once the province of science and business, is now finding its way into backyard gardens and greenhouses. People are learning to "farm" fish as a hobby, as a source of food, and for extra income.

That's why more than 40 aquaculture enthusiasts from across the country gathered this March near Waynesville, in the North Carolina mountains, for four days of instruction in fish-farming techniques. The course was sponsored by Haywood Technical Institute, and was prompted by the success of trout farms in the area.

Johnny Foster, from Sea Grant's Aquaculture Demonstration Project in Aurora, told the group about Sea Grant research work with rainbow trout, striped bass hybrids and tilapia, an African food fish well-suited to culture. He also offered advice about equipment, feeding and water-quality management on fish farms.

Foster taught the course along with Steven Van Gorder, a biologist from Rodale Research in Emmaus, Pennsylvania. Van Gorder outlined Rodale's design for using vinyl-lined wading pools and a biofiltration system to raise large quantities of fish on prepared feeds. Van Gorder emphasized the simplicity of the design, which he said could be built for under \$600.

Want to know more? Watch for the May issue of *Coastwatch*, which will include several stories on aquaculture. Or, contact Foster at the NCSU Aquaculture Demonstration Project, Rt. 2, Box 305, Aurora, N. C. 27806.



The word was out. UNC Sea Grant was sponsoring its second annual Workboat Expo in Morehead City, March 13 and 14, and everyone was invited. Around 4000 people attended the two-day event, which drew over 50 exhibitors showing boats (less than 25 feet), winches, nets, reels, outboard motors, diesel engines, radios, electronics and more.

Besides things to look at, there were things to learn. Seminars held both days—taught those who were interested about peeler crabs, gill netting, sail power, financing, net-mending, eel-fishing, fiberglass repair, marine insurance and more. Collington crabber Murray Bridges drew such a crowd to his peeler-crab seminar that some folks had to settle for listening outside the door.

The expo was organized by the Sea Grant Marine Advisory Services staff, with some help from the N. C. Agricultural Extension Service. Bob Hines, Larry Giardina and Penney Lewter, from the Sea Grant marine advisory office at Bogue Banks, handled many of the arrangements. Giardina says it was community support and hard work that made the expo a success.



Two years ago, Sea Grant initiated funds to introduce marine education into the State 4-H Program. B. J. Copeland, director of UNC Sea Grant, thought the 90,000 young people involved in this program could enhance their understanding of the land by learning more about the sea and marine resources. The result of this grant is the 4-H Marine Awareness Program which offers statewide activities and project materials on marine education.

Jayne Medlicott, who works with the program, says, "You don't have to live on the coast to get involved with

the marine awareness program or the activities." This spring, she will be introducing the program's project materials to 4-H agents across the state who will contact the leaders and clubs in their county. Subjects range from fishing and seafood to salt marsh ecology.

If you are interested in information on the program or on how to start a club in your area, contact your local county extension office or Jaynee Medlicott at the State 4-H Office. Single copies of the project materials are available free by writing to Medlicott at N.C. State 4-H Office, P. O. Box 5157, NCSU, Raleigh, N.C. 27650.

The cadet girl scout troop from Friendship, with a little help from UNC Sea Grant Director B. J. Copeland, won a trophy at the Girl Scout Expo held March 6 at the Cary Village Mall. The theme for this year's expo was water. Copeland says the troop's winning exhibit was among 40 to 50 exhibits displayed at the expo.



Two UNC Sea Grant publications have won awards in an international competition sponsored by the Society for Technical Communications (STC). *Coastwatch*, UNC Sea Grant's newsletter, won the society's highest commendation for "distinguished technical communication." *Coastwatch* is published ten times a year and has a circulation of 18,000. It is edited by Neil Caudle. Kathy Hart and Cassie Griffin are staff writers.

UNC Sea Grant's two-year report, *Sea Grant in North Carolina, 1979-1980*, won the society's second-highest award for "excellence." The 32-page report was written by Neil Caudle and designed by Mary Margaret Wade.

The two awards will be made during the 29th International Technical Communications Conference, to be held May 6 in Boston, Massachusetts. Both

*Continued on next page*



publications qualified for the international competition by first winning similar awards in regional competition conducted by the STC's Carolinas Chapter. Seven other UNC Sea Grant publications won awards at the regional level.

The Society of Wetland Scientists will hold its Third Annual Conference May 17-19 at Wrightsville Beach. The agenda includes field trips to marshes and pocosins, a technical-paper session, a poster session and a banquet. For more information on the conference, contact Bill Adams, secretary, P. O. Box 296, Wilmington, N.C. 28402.



Coastal North Carolina is a wreck-diver's paradise. Hundreds of shipwrecks, from blockade runners to modern trawlers, found in this "Graveyard of the Atlantic" make this area one of the most exciting dive spots on the East Coast. Some of the most popular shipwrecks are listed in Sea Grant's *Wreck Diving in North Carolina*.

*Wreck Diving*, written by Dennis Regan and Virginia Worthington, identifies and describes 43 of North Carolina's undersea shipwrecks. In addition, this 16-page booklet includes safety tips, a bibliography and a list of

nearby decompression facilities. To obtain a copy of this free publication, write UNC Sea Grant, Box 5001, Raleigh, N.C. 27650. Ask for publication number UNC-SG-78-13.

With spring comes an urge to explore the outdoors. And what better place to explore than a coastal salt marsh or estuary?

Among the things you can see during a salt-marsh excursion are the special plants that grow there—plants that can stand up to changes in tides and salinity, and to wind and wave action. To deal with their environment, salt marsh plants have special built-in features. The waxy leaves of the yaupon resist salt damage and retain moisture, while the leaves of the marsh pennywort rotate to avoid the sun's hottest rays.

Many of these plants were used for household aides, food and drink in the homes of the colonial settlers who lived in the coastal zone. Blackrush needles were cut for sewing needles, marsh mallow thickened soups and stews, and yaupon was brewed for tea.

If you would like to learn more about marsh plants, and have a guide to their identification, then write UNC Sea Grant. Ask for "A Guide to Salt Marsh Plants Common to North Carolina" (UNC-SG-81-04), written by Elizabeth Jean Wilson of the Hampton Mariners Museum. The cost is \$1.50.



Spring is the time of year sportsfishermen drag their gear out of storage and start making plans for weekend fishing trips. But unless the gear was stored properly after last season, they may be in for a big disappointment. Rods, reels and tackle need regular cleaning and maintenance to give first-rate results.

*Sportsfishing Gear Maintenance*, a Sea Grant Blueprint, gives tips on protecting and storing fishing gear. Special instructions for protection against saltwater corrosion are also included. For a copy of this free leaflet, ask for publication number UNC-SG-BP-81-1.

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*Coastwatch* is published monthly except July and December by the University of North Carolina Sea Grant College Program, 105 1911 Building, North Carolina State University, Raleigh, NC 27650-5001. Vol. 9, No. 4, April, 1982. Dr. B.J. Copeland, director. Neil Caudle, editor. Kathy Hart and Cassie Griffin, staff writers. Second-class postage paid at Raleigh, NC 27611.

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## COASTWATCH

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# COASTWATCH

Photos by Laurel Horton



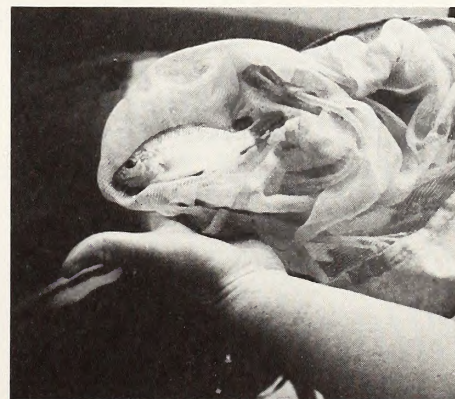
Joyce Moore and her daughters—Megan, 5, and Adrienne, 7—in their greenhouse. The fish tank and filtering system are in the background

## Aquaculture

Webster's says the word means "the regulation and cultivation of water plants and animals for human use or consumption." In some foreign countries, aquaculture has for years supplied much of the edible protein. And in this country, the great potential of fish-farming is beginning to attract the energies of scientists and business people alike. From Hawaii's prawn ponds to North Carolina's trout farms, aquaculture is on the rise.

But while some are steering fish farms toward large-scale food production, others are finding ways to lead aquaculture out of the lab and into the backyard. The experts agree on their advice to beginners: start small. Even an aquarium or two can teach some fundamentals.

This month, Coastwatch takes a look at small-scale aquaculture, and what it takes to try it.



A young tilapia in the dip net



# Farming fish in your own backyard—the basics

Backyard aquaculture can be as simple as stocking a farm pond with catfish, bream and bass for harvest with a hook and line. Or, with time and money to invest, fish can be raised in backyard pools or greenhouses, using the methods of intensive culture.

Backyard aquaculture is a fledgling enterprise in the United States. Private research companies like the Rodale Research Institute, the New Alchemy Institute and the Foundation for Self-Sufficiency are sponsoring small-scale aquaculture research and making inroads into reducing its costs. At UNC Sea Grant's Aquaculture Demonstration Project in Aurora, scientists are studying small-scale and commercial aquaculture, using eels, yellow perch, tilapia, rainbow trout and other species.

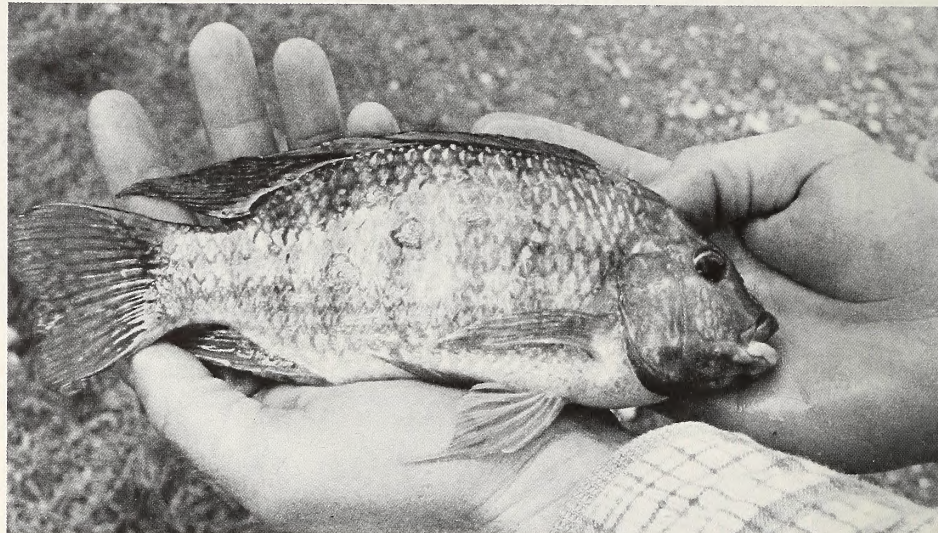
On a large-scale, commercial basis, two fishes, trout and catfish, are proving to be excellent culture species. Both are grown commercially in North Carolina. North Carolina's cold-water mountain streams make an excellent habitat for trout. Already 35 commercial, full-time trout farms are operating in this state, making it the second largest trout-farming state behind Idaho. There are 50 catch-out ponds where the public pays to fish for trout.

"I think North Carolina has the greatest potential for (trout) growth," says Charles Johnson, fishery training specialist for Haywood Technical College. "We have the benefit in that we have a better growing season because we have very little weather when the fish don't grow." Trout grow best in waters between 38°F and 70°F, the normal range of water temperatures in the North Carolina mountains, Johnson says.

Johnny Foster of the Aquaculture Demonstration Project says that it appears rainbow fingerlings can be raised in North Carolina's coastal waters during the winter. Foster has tested this idea by growing rainbow trout in cages in South Creek at the Aurora laboratory. The trout have prospered and have adapted well to brackish water, Foster says.

While trout farming is a growing enterprise in western North Carolina, a few commercial catfish farms are

Photo by Neil Caudle



*A tilapia raised at Sea Grant's Aquaculture Demonstration Project*

operating in the eastern part of the state. Catfish grow best in warm waters. In Mississippi, the catfish-farming capital of the world, almost 25,000 acres of ponds were in production in 1979. Throughout the United States, 76,680,000 pounds of cultured catfish valued at \$53,572,000 were sold in 1980.

At Lake Waccamaw, Robert Bey and Neil Allen are into catfish farming in a big way. Last year they sold over 8,000 pounds of farm-raised catfish, mainly to Raleigh restaurants. This

and he has started a catfish hatchery that he hopes will keep his raceways stocked.

But Bey says that beginners planning any commercial aquaculture enterprise on a large scale should spend several years raising fish on a small scale. "There are a lot of things you need to learn before you start putting big money into it," he says.

One of the easiest ways to set up a small-scale aquaculture project is to use a farm pond or water source already on your property, says Ron

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*"There are a lot of things you need to know before you start putting big money into it"*

*—Robert Bey*

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year Bey says he's putting 40,000 fingerlings in eight raceways in hopes of harvesting 3000 pounds of catfish per raceway.

After studying fish and wildlife management at Wayne Community College in Goldsboro, Bey took off for the Delta—Mississippi, Alabama and Florida—to see how they raised catfish. He used some of the methods that he saw there and combined them with some ideas of his own to build Buck Trail Aqua Farm on the shores of Lake Waccamaw.

Besides catfish, Bey raises tilapia, which eat the excess vegetation growing in his raceways. He is also experimenting with large Asian prawn,

Hodson, director of Sea Grant's Aquaculture Demonstration Project. "There are a substantial number of farm ponds that go unused every year that could be used to raise fish for food or recreation," he says.

A well-built and properly managed recreational pond can yield from 100 pounds to 300 pounds of fish for each acre of water surface. In piedmont and eastern North Carolina where waters are warm you can stock ponds with largemouth bass, bream and catfish. Ponds 5,000 feet above sea level in western North Carolina are usually cold enough to grow trout.

A pond should be stocked with the right kinds and numbers of fish for the



size of pond you have and the level of management you plan to follow. A pond that receives run-off containing herbicides or pesticides should not be used to raise fish, Foster says. Soil Conservation Services (SCS) agents in your county can help you decide how many and what kind of fish to stock in your pond.

Under a low-management system you can stock your pond with fish, fertilize the pond to encourage aquatic plant growth (which attracts worms, insect larvae and other aquatic animals for the fish to eat) and harvest by hook and line or by seine. If you want to follow a more structured management system, perhaps for a small commercial harvest, you will probably want to feed the fish a commercial fish feed.

Or perhaps you want to try cage culture. Steve Van Gorder of the Rodale Research Center says cage culture is one of the easiest methods of growing fish. At their Pennsylvania research location Van Gorder says tilapia, a hardy African food fish, and

catfish have been raised in pond cages. Researchers stocked a 3x3x4-ft. cage with 250 to 500 catfish. Van Gorder says at least 250 catfish must be put in each cage to prevent territorial fighting. The team fed the fish a floating feed, which doesn't escape the cage, and they periodically cleaned the cage of algae and debris accumulations to allow a good flow of water. When the fish were ready to harvest the cage was simply pulled from the pond. Van

no natural exchange of water from a creek or river. Under a closed system the same water is constantly being recirculated and cleaned.

Van Gorder says that using the Rodale method for backyard aquaculture, a person can set up a pool-culture system for between \$500 and \$550, not including labor, and that the system will pay for itself within five years. The costs run like this: a 12-ft. pool, three feet deep with a vinyl

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*"We believe more people would eat fish if they grew their own, and it would be a better-quality fish"*

*—Steve Van Gorder*

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Gorder says a pond will support the same number of catfish caged as it will without cages.

For people with no pond, there is another alternative—pool or greenhouse culture. Van Gorder says 100 pounds of fish or more can easily be raised in one season in a backyard pool. A backyard or greenhouse pool is a closed system, which means there is

liner—\$150; a clarifier (built from two 55-gallon drums and fabric mesh)—\$50; a biological filter—\$130; aerator (only needed if raising over 100 pounds of fish)—\$60; a hose and connector—\$10; two pumps—\$60. Besides the set-up costs, feed runs \$45 a year, electricity \$25 a year and fingerlings \$30 a

*Continued on next page*

Photo by Pat Seip, Rodale Press



*Experimental fish tanks set futuristic mood at Rodale's Pennsylvania research site*



year per 100. To extend the growing season for warm-water species, a plastic dome can be built for \$40.

How does the system work? The fingerlings are placed in the pool and fed a commercial feed. The biological filter and clarifier are used to remove the large amounts of wastes fish produce under the intensive feeding schedule. The clarifier removes the solid wastes, while the biological filter changes the ammonia in the water, which is toxic to fish, to nitrite then nitrate. The nitrate is food for the algae in the pool.

Van Gorder suggests stocking a backyard pool with tilapia. Tilapia are hardy fish, tolerant of a wide range of water conditions. They grow quickly in warm water. And, they taste good. "They're almost boneless," says Van Gorder. "They have a mild flavor, not fishy. The meat is very white, not mushy. To me it tastes better than trout."

Water quality can make a big difference in the fish you produce. "You should test the water that you have to make sure there's nothing in it toxic to fish, or to people who eat fish," says Van Gorder. The North Carolina Department of Agriculture's Agronomic Division will test water for its nutrient levels. Send a small plastic container half filled with water to the Agronomic Division, Plant Analysis Center, Blue Ridge Road, Raleigh, N.C. 27611.

Temperature is one very important aspect of water quality. Tilapia, for instance, grow faster when water temperatures are above 70°F. All species have an optimum water temperature at which they grow best and have the greatest resistance to disease or parasitism. "There is a range of tolerance above and below this temperature within which the fish will survive, but with increasingly reduced growth the farther the temperature is from the optimum," writes Van Gorder. "For a fish-culture situation to be economically feasible, the feed conversion and growing season must be maximized to reduce feed costs and obtain a harvestable-sized crop as quickly as possible."

One way to lengthen the growing season in the fall and raise water temperatures earlier in the spring is to insulate the pool with plastic. Using an inexpensive ¾-inch PVC frame draped with six millimeter plastic to cover the

Photo by Neil Caudle



*Sea Grant's Johnny Foster with pool and biological filter*

pool, the backyard aquaculturist can collect solar energy and store it more easily. Plastic-draped pools also keep water temperatures more constant.

Another method for extending the growing season is to raise fish in a greenhouse. Under this efficient method, the fish pool acts as a heat sink, keeping waters warm for the fish and storing solar energy for slow release into the greenhouse at night or on cloudy days. The nutrient-rich pond water can also be used to fertilize

plants growing in the greenhouse.

To test other aspects of water quality, many aquaculturists use a water-quality test kit. Test for levels of dissolved oxygen, nitrate, ammonia and pH. The tests should be made daily. Running the test and feeding the fish take about 20 minutes daily, Van Gorder says.

Backyard aquaculture, like gardening, is a means of self-reliant food production, Van Gorder says. "We (Rodale Research Center) don't ad-



vocate backyard aquaculture as a money-making venture. We don't sell equipment, only ideas. We'll tell you how to build and maintain an aquaculture system as inexpensively as we know how, using readily available materials. And we're always looking for ways to make backyard, small-scale aquaculture easier and less expensive. We believe fish is a good

source of protein that people don't eat enough of. We believe more people would eat fish if they grew their own, and it would be a better-quality, fresher fish."

While Van Gorder maintains you can raise fish for less than what it costs in the grocery store, other scientists are not so optimistic about the balance of costs and benefits in backyard

aquaculture. They stress that small-scale projects should be approached strictly as a hobby, and they warn of get-rich-quick schemes that make aquaculture seem too simple or more lucrative than it is.

To beginners, their advice is often, "Start small, and don't expect to get a lot without some effort."

—Kathy Hart

## For more information

If you'd like to know more about small-scale aquaculture, the following list of organizations and publications could help you get started.

### Organizations

Rodale Research Center (Publications available)  
RFD 1

Kutztown, PA 19530

The New Alchemy Institute (Publications available)  
P. O. Box 432

Woods Hole, MA 02543

The Ark Project  
Institute of Man and Resources  
Souris, Prince Edward Island  
Canada, COA 2B0

Cate Farm (Publications available)  
Goddard College  
Plainfield, VT 05667

Foundation for Self-Sufficiency Inc. (Publications available)  
35 Maple Avenue  
Catonsville, MD 21228

NCSU Aquaculture Demonstration Project  
Rt. 2, Box 305  
Aurora, NC 27806

Old Dominion University  
Dept. of Oceanography  
Norfolk, VA 23508

Soil Conservation Service (Publications available)  
One in each county

### Publications

*Backyard Fish Farming and Small Scale Aquaculture*, Keeton Fisheries Consultants, Inc., 2809 Dean Drive, Ft. Collins, CO 80521

*Fish Farming in Your Solar Greenhouse*, William Head and Jon Splane. Amity Foundation, P.O. Box 7066, Eugene, OR 97401.

*Fish Farming Handbook: Food, Bait, Tropicals and Goldfish*, E. Evan Brown and John B. Gratzek. AVI Publishing Company, Inc., Westport, CT.

*Principles of Warmwater Aquaculture*, Robert R. Stickney. John Wiley and Sons, Inc., New York, 1979. (\$22.50)

*Raising Fresh Fish in Your Home Waters*, Brenda Bortz, Jack Ruttle, Marc Podems and *Getting Food From Water: A Guide to Backyard Aquaculture*, Gene Logsdon. Rodale Press, Emmaus, PA 18049.

*Small-Scale Fish Culture Systems*, Steven Van Gorder. Rodale Research Report 80-12. Rodale Research Center, RFD 1, Kutztown, PA 19530.

*Small-Scale Culture of Fish in Cages*, Douglas Strange and Steven Van Gorder. Rodale Research Report 80-17. All available from: Rodale Research Center, RFD 1, Kutztown, PA 19530.

*Techniques for Small-Scale Spawning and Rearing of Channel Catfish*, Douglas J. Strange. Rodale Research Report 80-16. Rodale Research Center, RFD 1, Kutztown, PA 19530.

### Newsletters

*Network*, Steven Van Gorder and Douglas Strange (editors), Rodale Research Inc., 33 East Minor Street, Emmaus, PA 18049. \$15 per year.

### Magazines

"Aquaculture Magazine" (Includes annual buyers guide listing goods, supplies, and services). Published bimonthly, \$14 per year. Subscription Dept., P.O. Box 2451, Little Rock, AR 72203.

"Aquaculture Digest." Published monthly, \$24.00 per year. 9434 Kearny Mesa Road, San Diego, CA 92126.

"Progressive Fish Culturist." Published Quarterly, \$7.50 per year. Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

"Farm Pond Harvest." Published quarterly, \$4.00 per year. P.O. Box AA, Momence, IL 60954.

"Fish Farming International." Published quarterly, \$25.00 per year. Arthur J. Heighway Publications, Ltd., Heighway House, 87 Blackfriars Road, London, SE1 8HB.



# Family's aquaculture experiment passes taste test

Not everything that grows in the Moores' greenhouse is green. Just past the salad greens and vegetable seedlings is a 550-gallon tank. And inside swims a crop with gills, fins and an appetite for algae.

There's a bit of the pioneer in Joyce and Allen Moore. Aquaculture, for them, has been part experiment and part adventure. They've had a few setbacks—cold water, periods when the fish wouldn't grow, a clog-prone clarifier—but lately things are looking up. And this spring, their experiment passed its stiffest test when the Moores sat down to their first plates of home-grown tilapia.

"They were pan-size, with good texture and few bones," Joyce says. "The meat itself was very good. They tasted faintly of algae around the gut cavity, but we should be able to eliminate that problem by reducing the algae population and by holding the fish in fresh water for a day or so before we clean them."

The Moores' 8- by 20-ft. greenhouse, finished in 1980, adjoins the south side of the house they built themselves high in the mountains of Jackson County, N. C. Allen, who teaches biology at Western Carolina University in Cullowhee, supplies some scientific knowhow to their homesteading. Joyce, a weaver, is home enough to keep an eye on things and to make sure their garden, greenhouse, orchard and livestock stay productive. The Moores feel that food

is best and safest when it is fresh and homegrown. And that's one reason they've turned to aquaculture.

"We're definitely interested in food production," Joyce says. "And aquaculture is an efficient way of producing good protein."

Allen says that fish-farming and greenhouses are natural companions. Efficient solar greenhouses, he explains, use some kind of massive material to absorb excess solar energy. This heat sink can radiate warmth into the greenhouse as things cool off at night. And water is one of the best materials for storing heat.

"We needed five hundred gallons of heat storage in our solar greenhouse," Allen says, "so we thought, why not raise some fish in that water?"

Simpler said than done. First came reading and questioning that led them through piles of books and numerous interviews. A workshop at Haywood Technical Institute last year put them in touch with aquaculturists around the country.

They learned a lot about the biological problems they faced, but found information sketchy on the new-fangled idea of raising fish in home greenhouses. Much of their system's design is original and its components are mostly homemade, though they did get some professional help shaping the fiberglass fish tank.

"There's really nothing in the books that duplicates our system," Joyce says.

She designed the biological filter for the system herself, using a length of perforated drain pipe, partly filled with gravel, to aerate and detoxify the water. In the Moores' design, water drawn from the bottom of the fish tank is pumped into a clarifier, a plastic tank packed with a filtering medium to catch sludge. Cleared of most solids, the water is piped over the biological filter, where bacteria in the gravel do the rest.

"As far as we can tell, the water quality is good," Joyce says. "The best news was the lack of crud on the bottom of the tank when we drained it recently (to patch a leak). I think we can easily increase the quantity of fish without over-extending the system's carrying capacity."

The Moores stocked 50 tilapia fingerlings last spring. The largest have been eaten, and Joyce says they are thinking of adding catfish to cohabit with the tilapia. They hope the catfish will grow better during cool weather. The tilapia, which grow fastest when water temperatures are around 80° F, stopped growing altogether when temperatures in the tank dropped to 42° F last winter. The fish tank didn't hold quite as much heat as the Moores had hoped it would.

"We actually did have to heat the water some this winter, when the temperature outside at night went down to minus six or minus seven," Joyce says.

The problem could be solved by installing a heater, but the Moores are trying to keep things simple, low-cost and energy-efficient.

"You could easily have a net loss of energy if you used a heater all winter," Joyce says. She's hoping they can adjust things in the greenhouse and make better use of free sunshine.

Other problems with the system will have simpler solutions, the Moores believe. The Moores have concluded that the polyester fabric they had used in the clarifier was too closely woven. Acting on the advice of Johnny Foster, one of Sea Grant's aquaculture experts, they have recently installed bird netting in the clarifier. Now they're planning ways to reduce algae which have grown faster than the tilapia can eat them. (The tilapia have also been fed a commercial trout feed.)

Photo by Laurel Horton



*The Moores' greenhouse looks south over mountains*



Setbacks aside, the Moores say they're enjoying their experiment with aquaculture. "It's something like managing a little ecosystem," Allen says, "You can see how all these things fit together."

Their two daughters have had the benefit of a living lesson in biology, right at home. "It's just such a fun environment to watch," Joyce says. "Children love watching things grow."

The Moores recommend aquaculture as a hobby. And, while a background in science is useful, they say novices who study and design their systems carefully can be successful.

"We could have been a little more scientific about things," Joyce says. "Most of the time we've spent has been on developing the system, and we've spent virtually no time on it otherwise."

"Their advice to beginners is simple: 'Learn as much as you can before you get started,' Joyce says, and Allen agrees. 'You should put it all down on paper first,' he adds. 'Plan everything.'"

—Neil Caudle

Photo by Laurel Horton



Joyce Moore checking tilapia

## Clam gardening: an old idea with new potential

Like most types of aquaculture, clam farming began in the Orient. The Japanese have been raising clams for hundreds of years. Today, however, the relative importance and sophistication of clam aquaculture in the United States surpasses most other countries.

Most of this culture has been practiced in New England and Long Island, where it usually takes three to seven years to grow a marketable clam. But warmer waters and a longer growing season in North Carolina enable seed clams to reach market size in as little as two years. For this reason, commercial clam aquaculture has attracted interest in the southeastern states.

The hard clam (*Mercenaria mercenaria*), sometimes called the "quahog" lives along the East Coast of the United States. Increasing prices and decreasing harvest from natural clam beds have stimulated an interest in clam aquaculture in the coastal states, including North Carolina. Several relatively small-scale projects

have been started to investigate the feasibility of clam farming in our waters.

UNC Sea Grant has helped people interested in clam gardening since 1973. In addition to providing information and conducting trial seed-plantings along the coast, methods for excluding predators have also been developed.

To meet the demand for information specifically on North Carolina clam aquaculture, Sea Grant has published *Clam Gardening*. Written by Johnny Foster of the NCSU Aquaculture Demonstration Project, this publication offers specific information on obtaining and raising seed clams, leases and permits, location requirements and management of the garden. The appendix lists additional references and material suppliers.

If you are interested in clam aquaculture and would like a copy of this free publication, write Sea Grant, Box 5001, Raleigh, N.C. 27650-5001. Ask for publication UNC-SG-81-03.

### Clam Gardening



Sea Grant's Clam Gardening



# Put a bit of the coast in your home aquarium

You don't have to leave the coast behind after your vacation is over. You can keep living, breathing and multiplying sea creatures right in your home in a brackish or marine aquarium. And, you can learn something about aquaculture at the same time.

## Brackish-water aquarium

A brackish-water aquarium set-up imitates the ecology typically found in North Carolina's sounds and estuaries. The river-diluted sea water in this area has a low salinity, and is suitable for a variety of fishes and invertebrates, both freshwater and marine. To duplicate this environment, you will need the following equipment:

- **Aquarium tank**—all-glass tanks of at least 20 gallons are preferred. Larger tanks provide more space for inhabitants and more stability for the system. A cover for the tank is optional but handy, because it prevents animals from jumping out of the aquarium. Pick a sturdy stand or table for the tank (a 20-gallon aquarium will weigh approximately 170 lbs. when filled) away from direct light, and protect the aquarium from extreme heat or cold. Some light is necessary to promote the growth of algae, but too much will cause excessive growth.

- **Filter**—an outside power filter attached to the side of the tank is sufficient. Filtration and circulation remove particulates from the water and help maintain adequate dissolved oxygen levels.

- **Bottom material**—a thin layer of sand and gravel mixed with crushed shell, no more than one-half inch deep. A small amount of garden soil (one cup to two square feet of bottom surface) is good for certain fishes and invertebrates.

- **Decorations**—non-metallic rocks, bricks and sections of PVC pipe used sparingly are good for territory markers, hiding places and spawning surfaces. Clean seashells are also attractive, but use very few because they can collect decaying materials which affect the pH of the water.

- **Water**—can be collected from sounds and tidal creeks or mixed up from diluted sea-salt mix. Brackish water has about one-half to one-fourth

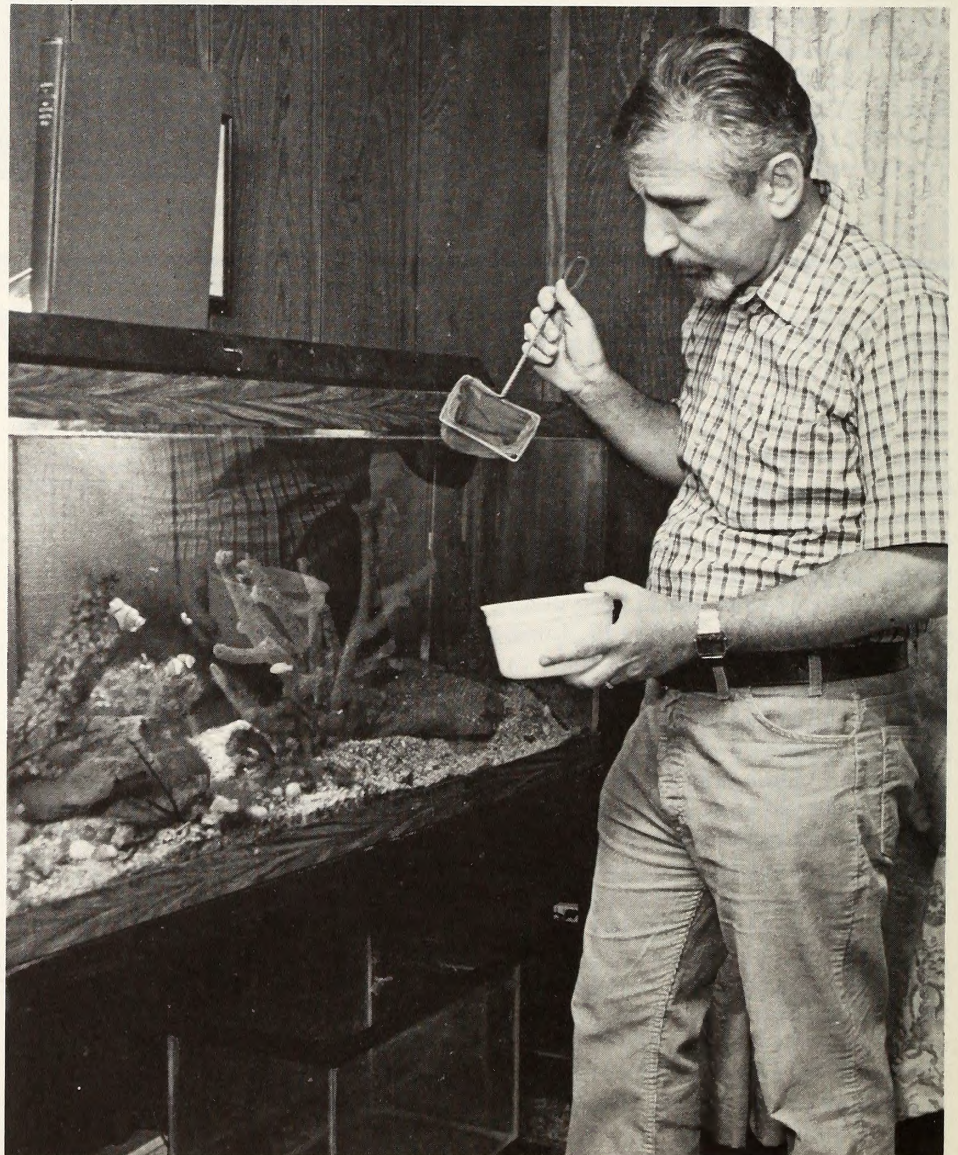
the amount of salt ocean water has, so multiply by two or four the amount of fresh water needed for every pound of sea salt mix (salinity levels are not very critical in the brackish system.) If using chlorinated tap water, let it age, or set it out in buckets, for a week to get rid of chlorine and other chemicals.

When you are ready to stock your brackish-water aquarium, the rule of thumb is one inch of inhabitants per gallon of water. Sea creatures can either be collected on a field trip to the coast or purchased from tropical fish shops, bait shops or scientific supply houses. Species that do well in this type of aquarium are marsh mummi-

chogs, sheepshead minnows, striped killifish, sailfin mollies, mosquitofish, mullet, eels, freshwater flounder (or hogchoker), grass shrimp, hermit crabs, starfish and sea cucumbers. If collecting species from estuarine areas, be conservation-minded—don't take more than you can use.

Most inhabitants in the brackish-water aquarium should be fed once or twice a day. There are three food categories: live foods, such as brine shrimp or small nematodes; dried foods, which are prepared and sold commercially, and fresh foods, such as chopped earthworms. Avoid leaving excess food in the aquarium, as it will

*Photo by Steven A. Wilson*



*Bob Goldstein working at one of his aquaria*



decay and deplete the oxygen.

Maintenance is minimal for the brackish aquarium. Once the tank has been completely filled with water, creatures and decorations, mark the water level. Any water lost to evaporation can be replaced with aged tap water. At least once a month, replace a quarter of the water with more brackish water, either collected or mixed up. This addition of water improves the water quality by dilution in addition to stabilizing the pH and replacing any trace elements used up by the inhabitants.

## Marine aquarium

Most of the inhabitants of a marine system are sensitive to changes in salinity and water quality, so these variables must be monitored. The following equipment is necessary to set up a marine aquarium:

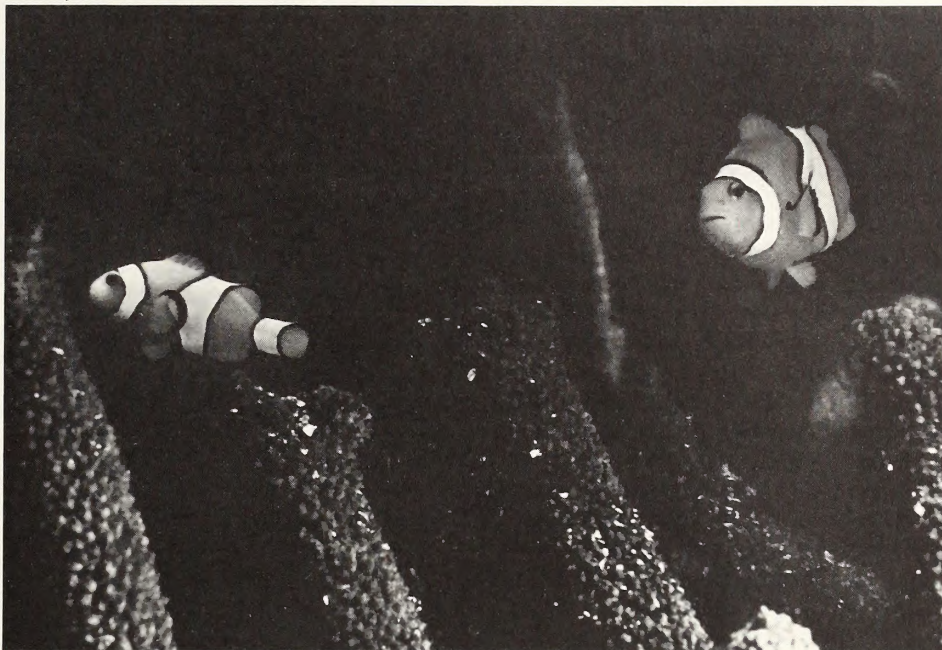
- **Aquarium**—choose at least a 20-gallon or 50-gallon, all-glass tank with no metal parts at all. A cover, with or without a light, will reduce the amount of water lost to evaporation and prevent salt water from splashing onto furniture, floors and electrical cords or outlets. Position the tank on a very sturdy stand or table away from direct drafts and sunlight. The chosen spot should also be a permanent one because the tank won't be portable once filled; sea water weighs approximately eight and a half pounds per gallon.

- **Filter**—an under-gravel filter inside and/or a pump-circulating filter attached to the outside of the tank are necessary. The under-gravel filter is important because it removes organic waste material, and the pump circulates water. The more circulation you have the better.

- **Bottom material**—use enough calcareous gravel for a layer two to three inches thick on the bottom. Crushed oyster shell, which is available at most feed stores, is excellent. Gravel must not be small enough to fall through openings in the filter. Rinse well before using to remove dust and debris.

- **Decorations**—clean seashells, corals, non-porous rocks and artificial plants are suitable for the marine aquarium, if used sparingly. If using seashells, check often for decaying material that may get trapped in openings. Do not use any metal objects or objects with any metal on them

Photo by Steven A. Wilson



*Clown anemonefish do well in saltwater tanks*

because metal in salt water is usually toxic to the inhabitants.

- **Water**—you can use natural sea water or artificial sea salt mix. You need sea water as pure as possible, so collect it when the tide is coming in to lessen your chances of getting contaminants. Filter all natural water through a funnel with dacron floss. Then store in containers with covers, undisturbed, for at least two weeks. This process

aquarium and spread this gravel over the gravel in your aquarium.

The tank is now ready for several hardy species, such as small blue crabs, hermit crabs or sea bass, which will provide waste material for the filter. In about three weeks, you can add other species that have either been collected or purchased. Several species suitable for a brackish-water aquarium, such as mummichogs, killifish, eels and star-

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*“You have to maintain the system very carefully and check it frequently”*

*—Bob Goldstein*

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will kill most microorganisms and algae. Aerate the water before you use it. If using an artificial sea-salt mix, mix according to package directions with aged tap water.

- **Hydrometer**—an inexpensive instrument that can be used to measure salinity, it is available at most tropical fish shops and biological supply houses. Salinity levels must remain fairly constant in the marine aquarium. A level of 30-35 parts per thousand is recommended.

Before stocking the marine aquarium, you need to culture the filter to bring bacteria into the system. These bacteria will use the waste given off by the inhabitants. If not removed, this waste could be poisonous. The easiest culture method is to obtain a cup of gravel from a healthy marine

fish, are also excellent choices for the marine tank. Rock bass, toadfish and small flounders are easy marine species to collect, and bivalves live reasonably well for a short time. Consider purchasing some of the exotic marine tropical species, such as the angelfish, butterfly fish and anemonefish, which exhibit brilliant colors. Avoid seaweeds, algae and some sponges as they don't survive and easily foul the tank.

Marine aquarium creatures should be fed twice a day, with all uneaten food removed to prevent decay. Live foods, such as brine shrimp or whole earthworms, and prepared dried foods are excellent. If you get ambitious and want to “grow” your own foods, check the references for information on rais-

*Continued on next page*



ing brine shrimp.

Regular maintenance is essential with a marine aquarium. After the tank is completely filled, mark the water level to check evaporation. Salts do not evaporate with the water, so remember to replace any water lost to evaporation with aged fresh water. The salinity level should be checked with the hydrometer every week if the aquarium is full of fish and less frequently if it is less crowded. Once a month, change one-quarter of the water and replace with aged natural sea water or freshly mixed artificial sea water (made with aged fresh water) of the same salinity and temperature as the tank water. Clean filters regularly, according to the package directions.

It is important to maintain your marine aquarium. Bob Goldstein, an aquarist and environmental consultant, says "A marine system is a closed system with no natural changing of water. The water is deteriorating steadily due to evaporation and the addition of wastes, so you have to maintain the system very carefully and check it frequently."

This information should get you started in setting up a brackish-water or marine aquarium system. If you would like to try breeding or growing your own food, check the references listed below.

### For additional reading

*Aquarium Systems*, edited by A. H. Hawkins. 1981. Academic Press, New York, NY.

*Caroline Marine Aquaria*, Carolina Biological Supply Company, Burlington, NC 27215. (Booklet can be ordered for \$1.00. Also, request free pamphlets on marine aquaria.)

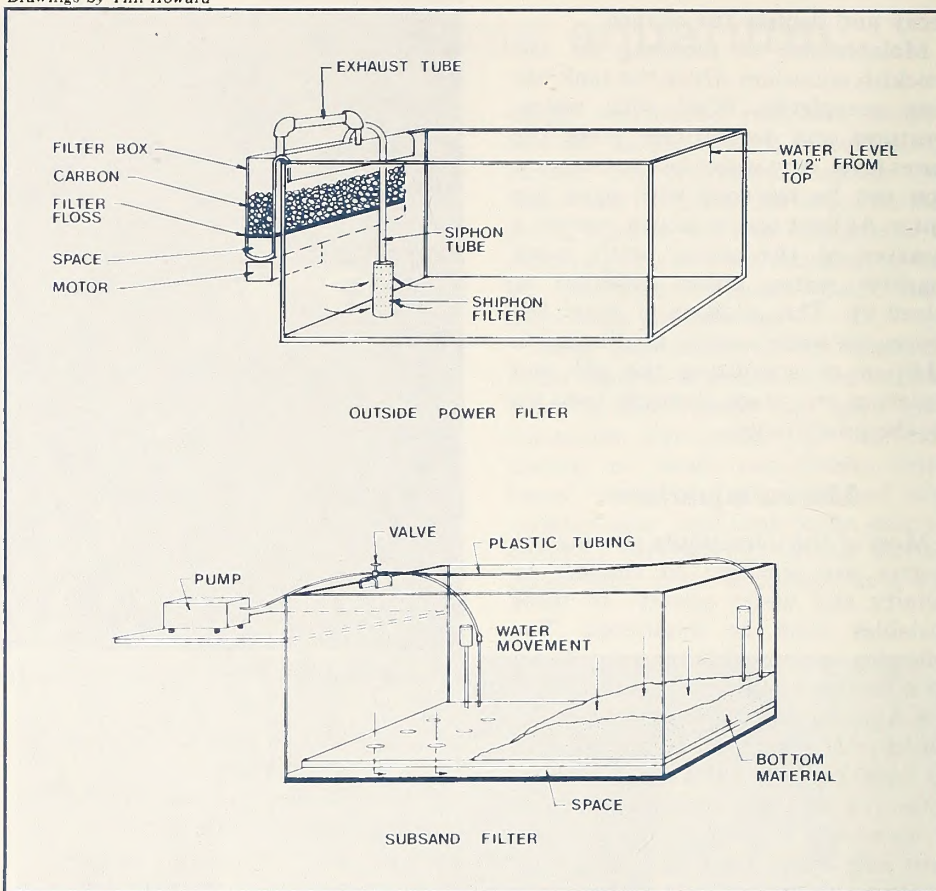
*Exotic Aquarium Fishes*, William T. Innes, L.H.D. 1979. Metaframe Corporation, Elmwood Park, NJ.

*Fish Farming Handbook: Food, Bait, Tropicals and Goldfish*, E. Evan Brown and John B. Gratzek. 1980. AVI Publishing Co., Inc., Westport, CO.

*How to Set Up a Saltwater Aquarium*, Project CAPE, Box 640, Manteo, NC 27954. (Booklet can be ordered for \$1.00.)

*Marine Aquarium Keeping*, Stephen H. Spotte. 1973. John Wiley and Sons, New York, NY.

Drawings by Tim Howard



*The outside power filter (above) and the subsand filter (below) remove particles and help maintain water quality*

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, Box 5001, Raleigh, N.C. 27650.

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To help us specialize our services, please answer these questions.

I am in the following line of work:

- |   |  |
|---|--|
| <input type="checkbox"/> Boatbuilding/Repair    | <input type="checkbox"/> Marine operator                 |
| <input type="checkbox"/> City/County government | <input type="checkbox"/> Marine recreation               |
| <input type="checkbox"/> Commercial fishing     | <input type="checkbox"/> Mass media                      |
| <input type="checkbox"/> Educator               | <input type="checkbox"/> Seafood processing/marketing    |
| <input type="checkbox"/> Farming                | <input type="checkbox"/> State government                |
| <input type="checkbox"/> Homemaker              | <input type="checkbox"/> University professor/researcher |
| <input type="checkbox"/> Lawyer                 | <input type="checkbox"/> Other _____                     |

Coastal property owner ☐ yes ☐ no Boat owner ☐ yes ☐ no



# THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings and workshops, and new publications. For more information on any of the projects described, contact the Sea Grant office in Raleigh (919/737-2454).



Part of the Roanoke River basin, the Camassia Slopes in Northampton County, harbors more than two dozen species of wildflowers designated as endangered, uncommon or rare in North Carolina. The most noteworthy wildflower, *Camassia scilloides*, or wild hyacinth, for which the area is named, is an endangered "disjunct" because it is usually found only west of the Appalachian Mountains.

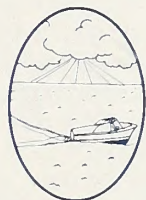
At home in Midwestern river valleys and prairies, the Camassia grows thickly in the Roanoke River basin, one of only two known occurrences in North Carolina. Biologists believe the flower's presence there can be attributed to the area's unusual soil. The soil, which is highly basic, is much like the soil found in Midwestern river basins and very unlike the acidic soils found elsewhere in the Roanoke River basin. Because of the different soil, the slopes harbor such other endangered, uncommon and rare plant species as the James' sedge, the eastern wahoo, the sessile trillium, the wild blue phlox, the purple larkspur and the three-bird orchid.

The Camassia Slopes have been donated by the Union Camp Corporation, a forest-products company, to The Nature Conservancy, a non-profit conservation organization, for preservation. The preservation of the slopes is part of a joint, long-range effort by the state and The Nature Conservancy, through its state chapter, to protect the Roanoke River basin, a refuge for many rare species.



Jim Murray, director of Sea Grant's Marine Advisory Services, has announced an opening for a marine advisory agent. Working from a Manteo location, the agent will be responsible for developing an extension education program for 10 counties in northeastern North Carolina. Candidates must have a knowledge of commercial fishing gear and gear technology. A bachelor's degree in marine or fisheries science and/or experience in commercial fisheries is preferred.

Applicants should contact Dr. William H. Queen, director, Institute for Coastal and Marine Resources, East Carolina University, Greenville, N. C. 27834, or call (919) 757-6779. Applications must be received by June 11. East Carolina University is an Affirmative Action/Equal Opportunity Employer.



A man pops the top of his favorite beverage as he leans back in his boat waiting for a fish to tickle his line. He tosses the pop-top overboard.

A small fish, attracted to the light-reflective top as it drifts downward, attempts to swim through the top. The ring won't slide over the fish's fins. The fish is now encircled with a pop-top that may mean its death.

Littering coastal water can be more than just unattractive; it can kill and maim wildlife. Three kinds of litter are particularly dangerous to wildlife: plastic six-pack rings, pop-tops from aluminum cans and monofilament fishing line.

Plastic rings and monofilament line can easily become wrapped around the heads, necks and feet of waterfowl and aquatic birds, disturbing their flight, swimming and feeding abilities, often with fatal results.

Fish that become entangled in litter may also die because the litter inter-

feres with feeding, restricts swimming, damages skin and scales, or inhibits growth.

What can you do to prevent these problems? Don't throw your trash into the water. Keep a litter container with a lid on board and use it. When at the beach, pier or marina, use trash containers provided there, or take your trash with you and discard it at home. If you see litter floating on the water, help the birds and fish. Pick it up.



About 100 Florida builders, architects, engineers and officials recently got some advice from North Carolina on how to build safer coastal buildings. The occasion was a workshop held March 25-26 in Pensacola Beach. The workshop was sponsored by the Federal Emergency Management Agency.

Spencer Rogers, Sea Grant's coastal engineer, spoke to the group about natural hazards during hurricanes and floods. He discussed the effects of the storm surge, winds, waves and erosion, and offered some guidelines on how to select coastal building sites.

Closer to home, the topic was erosion when Rogers spoke to a group of 30 property-owners at a public hearing conducted April 10 by the Topsail Beach town council. Rogers explained how and why beachfront and estuarine erosion occur, and discussed the advantages and disadvantages of several erosion-control techniques.

Shipwrecks off North Carolina's coast, like artificial reefs, attract and shelter underwater life. They also attract divers. But few regions can offer such a wealth of shipwrecks, and divers from across the country have been trying to get reefs built in waters near them.

Jim Murray, director of UNC Sea Grant's Marine Advisory Services, spoke to many of those divers recently,

*Continued on next page*



when he addressed the 12th Our World Underwater conference, held May 1-2 in Chicago. Murray, a diver himself, told the crowd of 400 about advances in artificial-reef technology, and suggested ways diving clubs could get new reefs started. He was part of a panel of experts that included representatives from Sea Grant programs in several states.

Groups interested in Murray's presentation, which includes a program of slides, should contact him at Sea Grant, 105 1911 Building, NCSU, Raleigh, N. C. 27650, or call (919) 737-2454.



Where can you find information on field trips, films, government resources and aquaria, all under one cover? In the new Sea Grant publication, *Connections: Guide to Marine Resources, Living Marine Systems and Coastal Field Trips*.

*Connections* is the new, revised appendix to the North Carolina Marine Education Manuals, which are published by Sea Grant to help educators put marine education into their lessons. Written by Lundie Spence, Sea Grant's marine education specialist, and Jaynee Medlicott of the 4-H Marine Awareness Program, the 94-page illustrated guide has sections on field trips, resources and references and aquarium systems for the classroom or school.

Single copies of *Connections* are available to North Carolina educators free of charge. For out-of-state re-

quests, there is a charge of \$2.00. Write UNC Sea Grant, P. O. Box 5001, Raleigh, N. C. 27650-5001. When ordering *Connections*, please request publication number UNC-SG-82-1-F.



Seafood was on both the menu and the agenda when the Southeastern District Extension Homemakers met April 1 in Carteret County. Over 800 extension homemakers from a 17-county area heard Frank Thomas, NCSU extension seafood specialist, discuss how to buy and preserve fresh seafood. Joyce Taylor, Sea Grant's seafood technician at the NCSU Seafood Laboratory, showed several new ways to prepare seafood and had samples of bouillabaisse, clam bake, deviled crab with flaked fish, and fish flakes and macaroni salad on hand for tasting and testing.



Surf fishing, trawling and tasting unusual seafoods are just a few of the activities planned for a workshop for teenagers this summer. Sponsored by the 4-H Marine Awareness Program, the workshop will concentrate on marine resources and will include field trips and programs with the Division of Marine Fisheries, NCSU Seafood Lab and N. C. Marine Resources Center at Bogue Banks.

The summer workshop will be held August 8-13 at Mitchell 4-H Camp in

Swansboro. Registration is open to high school juniors and seniors and to graduating seniors who have not entered college. The fee for the week-long workshop is \$125, with a \$50 deposit due upon registration. The deadline for registration is July 1.

For more information on the workshop and registration, contact Jaynee Medlicott, State 4-H Office, 202 Ricks Hall, North Carolina State University, Raleigh, N.C. 27650 (919) 737-3243. Or call the 4-H agent at your local county extension office.

B. J. Copeland, UNC Sea Grant director, has awarded Mary Beth Dail, a prospective graduate student at the University of North Carolina at Wilmington (UNC-W), a UNC Sea Grant Graduate Fellowship to begin her masters thesis study in marine biology in the fall. Dail, who will complete her undergraduate studies at UNC-W this spring, plans to study the chemical differences and changes in the shell of a crab during its molting period.

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## COASTWATCH

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# COAST WATCH

Photo by Steven Wilson



## Fresh vs. frozen

Frozen seafood is better. At least, it will be someday.

Please don't give us up for bonkers, just yet. And no fair boasting about that bluefish you

*Continued on next page*





Boxes of fresh-frozen seafood line a blast freezer

pulled out of the surf this morning, just in time for breakfast. Nothing will ever taste better than that.

We're talking averages here. Unless you live right on the coast, the average "fresh" seafood you buy may be six days old. Two weeks out of the water is not so unusual.

Today's commercial blast freezers, on the other hand, can stop the freshness clock at about two days, if that's how long it takes the fish to reach the freezer.

We'll admit, frozen fish may have deserved its unsavory reputation in years past. Not anymore. Science has found a way to drop the temperature without dropping the flavor. Still skeptical? Read on. This month's *Coastwatch* looks at what happens when you freeze a fish—the right way.

## Eight days in the life of a seafood

Consider the flounder fillet on your grocer's meat counter. Perhaps it landed whole and alive on the deck of a trawler somewhere off North Carolina. Had it been possible for you to clean and cook the fish that moment, you'd have tasted flounder at its peak: firm, fresh and delicious.

But shortly after it reaches the boat, the flounder and most of the rest of the catch are shoveled below decks and iced for safe-keeping. The clock is already taking its toll on the flounder's flavor.

After another night or two of fishing, the crew heads home.

Elapsed time: two days.

At the fish house, things happen fast. The flounder are unloaded, sorted, cut, boxed, iced and loaded onto trucks—all in a matter of hours. From the packer, the trucks often travel to wholesale distributors, where the flounder might spend another night or two before it is packed off to grocers and restaurants across the Piedmont and Coastal Plain. Often, these shipments reach the grocery stores on Tuesday nights. The meats manager unpacks the boxes, and trays and wraps the flounder for sale the next day.

Elapsed time: five days.

Wednesday and Thursday, sales are good, but Friday is the big day for seafood. And Friday evening might have found you at the meat counter,

picking up a package of "fresh" flounder.

Elapsed time: eight days.

This is only a hypothetical case. There are other routes the fish can take to your market, and sometimes the elapsed time is a day or two less. Occasionally, it is even longer—sometimes two weeks or more.

His studies, using panels of tasters, market studies and lab tests, have shown that most seafoods, properly frozen and prepared, are at least as good to eat as fresh products.

"There's maybe a slight difference in the appearance of frozen seafoods, but when they're cooked there's no difference at all," Lanier says. "In fact,

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*"Most panels cannot distinguish between a fresh fish and one that has been frozen over a year."*

—Tyre Lanier

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Handled correctly, many week-old fish are still very good. But much beyond that one-week interval, quality drops quickly. The fish teems with activity. Bacteria convert nutrients into smelly new compounds. Unsaturated fats and oils become rancid. Enzymes break down muscle proteins and reduce the texture to mush. Eventually, time will make the meat inedible.

Can the clock be stopped? Almost. But ironically, the very means for preserving seafood's quality is the method many of us equate with inferior seafood: freezing.

Tyre Lanier, of the food science department at North Carolina State University, has for five years been conducting Sea Grant research into the packaging and preserving of seafoods.

most panels cannot distinguish between a fresh fish and one that has been frozen over a year."

But Lanier says that such quality depends on fast-freezing the product in a good package, at temperatures below -10° F. A home freezer won't do the same job.

"If you freeze seafood, all you do is crystalize the water," Lanier says. "If you fast-freeze it, the water crystals are very small, and they do the least damage to the product. The faster you freeze it and the colder you hold it, the less damage."

Uneven cooling due to the cycling of some freezers can build larger crystals and reduce the quality of frozen meats, Lanier adds.

Lanier says that some seafood species keep longer than others. Low-



fat fish such as croaker, trout and flounder can taste fresh after more than a year of frozen storage. But with fatty species, including bluefish, mullet and mackerel, rancidity is a problem after two or three months. Some fish common off northern states, notably cod, hake and haddock, freeze poorly because enzymes toughen the meat. But for the most part, North Carolina's common species—shellfish included—could be frozen with excellent results, Lanier says.

The technology is tested and ready for quick-freezing seafoods. Modern blast freezers, and equipment using carbon dioxide and nitrogen gases, can bring fish down to  $-20^{\circ}\text{F}$  or even  $-30^{\circ}\text{F}$  in hours or minutes. Fleets from Europe and Japan fish around the world, processing and quick-freezing seafoods aboard their ships. Fish handled this way are frozen near their peak, just hours out of the water.

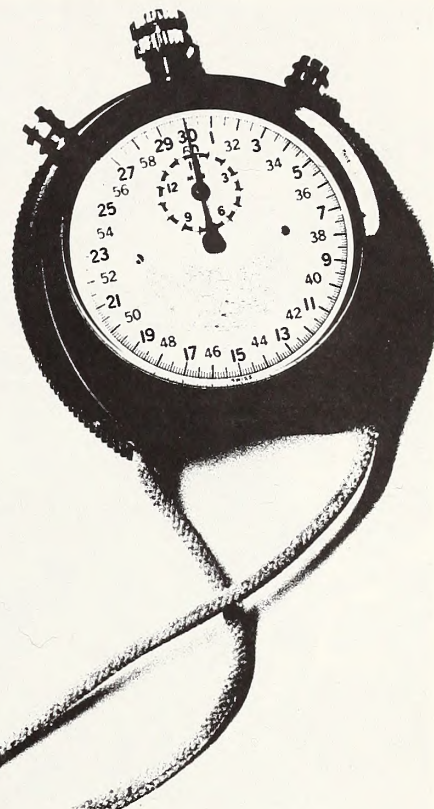
Lanier says that when Germany first tried marketing fresh-frozen products from their factory ships, many consumers thought the fish

tasted "too fresh," and wouldn't buy them. This bias didn't last long. (North Carolina's one experiment with on-board processing and quick-freezing has been a Wanchese boat designed specifically for squid. The enterprise has been unable to find a market for its product.)

But even without these expensive on-board freezers, the freshness clock could be stopped at three or four days, if fish were frozen dockside. Much of Lanier's Sea Grant work has been directed at solving the technical problems such a practice might pose. Studies by assistants on the project found that fish gutted before cold storage kept better than fish left whole. Another study set some objective guidelines for measuring quality in fresh and frozen seafoods.

Much of the research has been concentrated on the seafood package itself. "A good freezing job involves not only rapid freezing but also wrapping in some sort of a package that provides a good barrier to oxygen and moisture

*Continued on next page*



*Photo by J. Foster Scott*



*Fish landed on this bottom-fishing trawler may take up to 14 days to reach the dinner table*





*Tyre Lanier explains proper freezing techniques for seafood*

migration," Lanier says.

Moisture leaving the food causes freezer burn. Oxidation of the fat can follow, leaving the fish with a dry, chalky taste and an "off" flavor.

Lanier says the traditional frozen-food cartons have their faults, and have perhaps contributed to the consumer's low opinion of frozen seafood.

"The waxed cardboard box can be a good oxygen barrier, but because it's not skin-tight to the products, moisture can migrate out of the food, unless there's another package inside," Lanier says. "Any time you see frost accumulation in one of these boxes, you know you've had some freezer burn."

Lanier's tests have shown that frozen seafood is best protected when it is vacuum-packaged in a tight-fitting, plastic film. But such packages are expensive. And, in North Carolina, where much of the seafood is still sold wrapped in yesterday's sports pages, not every seafood handler has either the means or the know-how to modernize.

Lanier says it will take education, and a few good success stories, to con-

vince the industry to try quick-freezing fresh seafoods. It will also take some convincing to dispel the public's attitude that all frozen fish is inferior.

"That attitude is based on bad experiences in the past, when most seafood was frozen because it was getting old," Lanier says. He adds that no matter how well you freeze and

they need to promote fish, that they need to offer fish in as much variety and quality as they do red meat and chicken," Lanier says. "This has not been done in the past."

Hank Walker, frozen-foods buyer and merchandizer for the Charlotte-based Harris-Teeter chain, says his company's 71 stores have for the last

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***"The big problem is in convincing the supermarket retail chains that they need to promote fish, that they need to offer fish in as much variety and quality as they do red meat and chicken."***

***—Tyre Lanier***

---

package a fish, it won't come out of the package fresh unless it went in that way.

Many grocery stores have little experience with seafoods, Lanier says, and are reluctant to carry anything more than a few cuts of unfrozen flounder or trout, and a few boxes of shrimp and breaded seafoods.

"The big problem is in convincing the supermarket retail chains that

year reported declines in sales of processed, frozen seafoods. Most of these products are battered or breaded outside North Carolina.

"I see the market going more into inexpensive, minced-type products," Walker says, "simply because people who would buy your high-ticket items are leaning toward the local fresh items, which are becoming more available to them. Walker says that his



company was impressed with the unbreaded, fresh-frozen seafoods offered by a Charleston, S. C. firm (see story on page 8).

Charlie Watson, who buys local seafoods for Harris-Teeter, says he's handled mostly flounder and black bass this spring. The fish come into stores on Tuesday nights, and are sold through Saturday. He knows of nobody from North Carolina offering quick-frozen fish.

"We would consider buying frozen fish," he says. "In our stores, frozen sells as well as fresh. The decision would be based on whether the price and quality were right, and whether we could count on the fish being available."

Watson says a good line of frozen seafoods would help his stores keep fish in the inventory year-round.

"Fresh supplies are hard to come by," he says, "especially in the summer. Frozen seafoods would be easier to count on."

Hank Walker says the stigma attached to frozen seafoods is outdated. He says that many seafood handlers freeze fish, then let it thaw to sell as "fresh."

"The majority of shrimp is frozen in five-pound blocks," Walker says. "And there's a good bit of so-called fresh product that has been frozen at one time. You're foolish if you believe all this fresh seafood has never been frozen."

Walker says Harris-Teeter won't sell thawed seafood as fresh.



*G.J. Coles and Coy labels used in NCSU marketing study*

ready to consider radiation pasteurization again," Tyre Lanier says. "With it, we could extend the shelf life of seafoods probably twenty or thirty days. But if you had to use the word 'radiation' on that package, it would probably kill the whole concept."

So Lanier and others believe modern freezing may yet prove the best way to reach more people with better seafood. The trick is to somehow make a frozen fish just as appealing on the meat counter as, say, a pork chop or ribeye—a difficult job if that flounder fillet is frozen stiff.

"People generally prefer to buy meat products unfrozen," Lanier says. "One reason is that they can judge the quality of unfrozen products better."

As part of his Sea Grant research, Lanier and his associate, Reino

two stores near Raleigh and Chapel Hill. The test lasted five weeks, and new fish were stocked each week.

The results were surprising: Overall, the previously frozen fish sold as well as or better than fresh fillets. In fact, previously frozen flounder outsold fresh flounder by about 50 percent, although fresh trout did outsell thawed trout by 25 percent.

The results seem to indicate that the public may not be as reluctant to buy previously frozen seafoods as some dealers and processors have imagined. Lanier says the success of an Australian firm, G. J. Coles and Coy, has shown that the freeze/thaw method can be very popular with consumers, even in a country of beef-eaters. Coles' sales were around \$12 million last year.

Lanier says that while the freeze/thaw method can provide an appealing product, there are some limitations. A thawing fish can lose moisture and spoil the looks of a package—repackaging might be necessary in some cases. And, after they are defrosted, fish have a slightly shorter shelf life than their fresh counterparts. It would be easier, Lanier says, to simply leave the fish frozen.

"As a technologist, I don't really recommend freezing fish and then thawing it before you sell it," Lanier says. "But as a realist, that's the best way to handle fish and sell the most." How can the seafood buyer tell a good frozen product? Lanier advises consumers to choose fish in a good, airtight package. And, he says, choose a brand name you can trust.

—Neil Caudle



*Labels used in NCSU chilled-fish marketing study*

But if freezing turns buyers off, other ways of preserving food fare no better. Chemical preservatives are unpopular with consumers these days, and radiation techniques—if they're approved—would likely meet resistance as well.

"After twenty years of research, the Food and Drug Administration is

Korhonen, conducted a market study of the public's reaction to "previously frozen" seafoods—fish quick-frozen but defrosted before they were set out for sale. The team packaged similar cuts of trout and flounder and labeled them as to whether they were "previously frozen" or "strictly fresh." Fillets were offered at \$2.99 a pound in



# Fisheries hamstrung By 'fresh' market

Fresh-frozen seafood may someday offer inland consumers good seafood more consistently. It may also help relieve some of the commercial fishing industry's toughest problems.

Gluts, scarcities and market fluctuations have long plagued the industry, especially here in North Carolina, where most of the seafoods are sold whole and unprocessed.

Sam Thomas, a Sea Grant seafood specialist at the NCSU Seafood Laboratory in Morehead City, says that, for now, seafood prices in the state are governed by the fresh market. Because unfrozen seafood is so difficult to handle, store and transport, distribution is very limited. Often, grocers will save space for only the most familiar species. To get assured supplies at the right times, dealers pay top prices. But when a glut comes, perfectly good fish are sometimes dumped overboard for want of a buyer. Other times, scarcities among the popular species leave fishermen with nothing to fish for.

"If you're a fisherman, you may come to the dock one day and get fifty cents a pound for trout," Thomas says. "The next day, you may get twenty. If we had a good market for frozen seafood, the processor could look at a more stable price at his end, and from that, he could probably offer a more stable price to a fisherman."

Thomas spends much of his time advising seafood processors on how to modernize their plants and improve efficiency and sanitation. He and the Sea Grant marine advisory agents he works with see many very edible species of fish going begging, while fishermen struggle to stay afloat.

They say a good market for fresh-frozen seafoods might enable the industry to put more variety into the grocer's meat case.

But Thomas admits the industry has a lot of work to do first. There are few modern commercial freezers in the state, and channels for marketing frozen seafoods don't exist here yet.

"For the most part, we could offer a better seafood shipment frozen than we can fresh," Thomas says. "It's just going to take a lot of effort to get people to change their way of doing things."

## Racing to beat the clock

*Time is fresh seafood's enemy, from the minute the catch is made. At the fish house (below), seafood is quickly weighed and packed in ice. Many fish arrive whole at markets, where they're often sold wrapped in newspapers (right).*

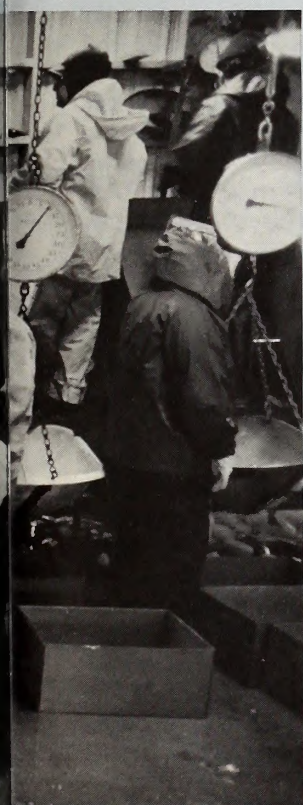
Photo by Gene Furr



Design by Neil Caudle



Photo by Steve Murray





# Some fresh ideas for frozen seafood

At least two seafood processors, one in North Carolina and the other in South Carolina, are trying to change the public's attitude about frozen seafood.

Jim Hudson, owner of Cap'n Jim's Seafood in Zebulon, is struggling to sell grocers on the idea of freeze-and-thaw seafood, and he's using a new tray design to do so. Gary Swift, president of Port City Processing Company, Inc., in Charleston, S.C., is using slick marketing techniques and a special vacuum package to get his frozen seafood into supermarket frozen-food counters. Both men believe that good freezing and packaging techniques, fresh fish and a marketing strategy will help frozen seafood become a larger part of the American diet.

In a processing plant more than 100 miles from the fishing docks, Jim Hudson has developed a tray pack that allows him to freeze and thaw fish in the same package. Hudson has been working on his idea for almost five years and expects to spend \$2 million to get his freeze-and-thaw seafood into the grocery stores.

Under Hudson's method, fresh fish,

no more than two days old, Hudson says, are trucked to the Zebulon plant. The fish are then filleted or dressed, individually quick-frozen and glazed to prevent rancidity and freezer burn. They are packaged in one-pound portions in Hudson's thick, padded trays, which are designed to absorb the moisture lost from the fish as it thaws, keeping it looking dry. The fish are stored in vacuum-packaged master boxes at -10° F until they are sold.

Once sold, usually to supermarket chains, the fish are shipped to the chain's distribution center where they are thawed under 33° to 34° F refrigeration. But Hudson would prefer that the fish go to the stores before it is thawed. "If the supermarket meat managers would thaw the fish properly," Hudson says, "Then they could assure themselves of no spoilage."

Hudson's fish remain in refrigerated meat counters three-and-one-half days before meat managers are instructed to pull them. "If frozen fish are handled well, my freeze-and-thaw fish can taste just as good as fresh seafood," he says. "But the key is to start with a fresh product. Frozen seafood has gotten a

bad name because many processors were freezing the fish they couldn't sell fresh as a last resort to keep from losing money. Freezing doesn't make the fish good again. It's no wonder the public thought frozen seafood was bad."

When thawed, Hudson's freeze-and-thaw fish looks almost identical to its fresh counterpart. But the label reads "Safe to refreeze and refrigerate," a sign to the consumer that the fish has been frozen.

Hudson claims other processors sell thawed seafood but never label it as such.

"I sometimes sell my frozen fish to other wholesalers who thaw it and sell it as fresh to the same chain stores who won't buy my fish when I tell them up front that it is frozen," Hudson says.

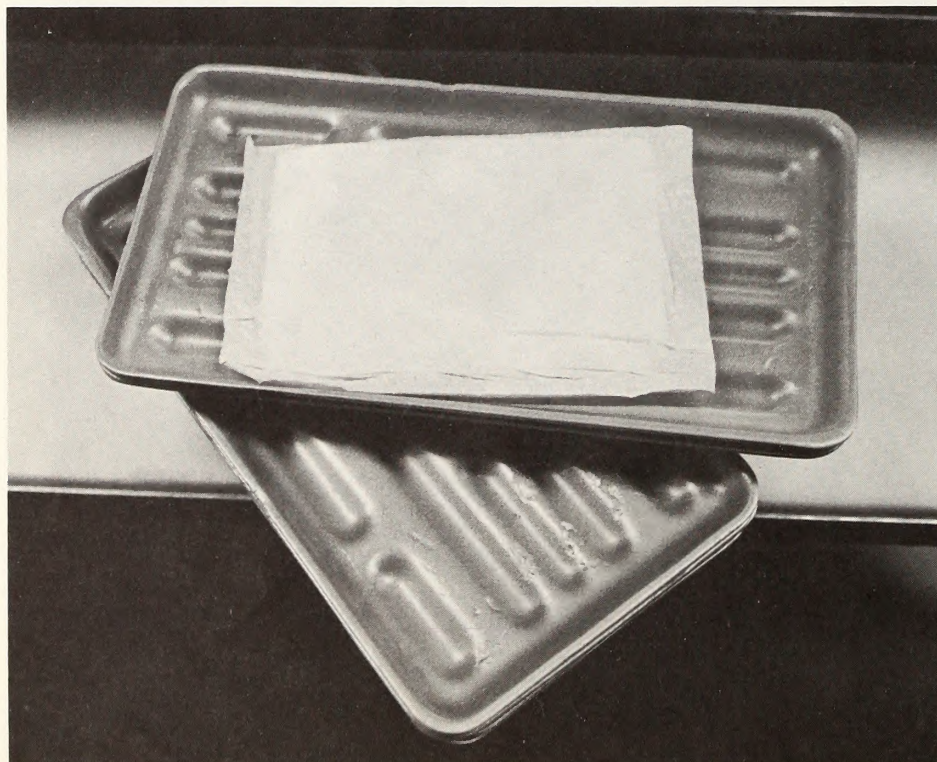
If offered a consistently high-quality product, the public would learn to accept freeze-and-thaw seafood and like it, Hudson says. But his problem may be getting chain-store fish buyers to stock his product. Hudson believes a good education and marketing program may solve that problem. He has already hired a marketing research company to find out how consumers prefer their fish (whole or filleted), and when fish sell best.

Despite marketing research and the time and money spent on developing his freeze-and-thaw processing methods, Hudson is struggling to keep his processing plant open. "Right now I'm hanging on by my toenails," he says. "I may spend my last penny getting this thing going."

"Doing business in the 80s" is the theme Gary Swift uses to run Port City Processing Company in Charleston, S.C. Swift believes most seafood processors are behind the times in technology and marketing techniques. "Most of the processors aren't willing to spend the time and money needed to do anything new," he says. "They are conservative by nature and as long as they're making a little profit they're content. But because of that they're still doing business the way it was done in the nineteen-thirties."

Swift is using new technology to get his frozen fish into supermarkets. Working with seafood specialists at Cornell University in New York, Swift developed a film he uses to vacuum-pack his frozen fish. Swift sells the fish

Photo by Neil Caudle



Hudson's specially designed tray packs



he processes frozen, in one-pound packages for consumers to thaw at home or transfer to their freezers for storage. The special fish film, made of a combination of nylon, polyester and syrlene, extends the shelf life of his frozen product and eliminates dehydration.

Swift spent two-and-a-half years developing his vacuum-packing techniques and now he's putting them to use. Swift markets a line of gourmet frozen seafoods under the name Tropical Seas. The line includes scallops and swordfish, at about \$3.99 to \$7.99 a pound. A lower-priced line offers such products as black bass and red snapper. The Kroger supermarket chain in New York City is buying Swift's seafood. He processes 10,000 pounds of fish a day in his Charleston plant, he says.

Swift says he has learned good marketing can go a long way toward getting his frozen seafood from the frozen-food counter into the shopper's grocery cart. He's hired a Madison Avenue firm to tell him who's buying fish, how to target those consumers and how to persuade them to buy his fish.

Swift says that of every dollar spent on food in the U.S., 83 cents are spent in chain stores. People are eating in restaurants less often and preparing more of their food at home, he says. With that in mind, Swift chose to knock on the doors of supermarket chain-store buyers to sell his product rather than restaurants or independent grocery stores.

Through the marketing research, Swift has learned that people who buy fish tend to be more health-conscious in selecting their food. He has aimed his advertising slogan—"Fish—Put Your Diet in the 80s"—at that group.

Besides knowing his market, Swift is using some slick advertising techniques to get the public to try his frozen fish. In marketing his frozen golden tilefish, Swift alludes to French cuisine. In one of his ads, a picture shows an elegant place-setting and a plate of tilefish covered in a creamy sauce. Below the picture are the words: "The French call it elegant fish."

"To change people's opinion you can use two methods, sanctions or rewards," Swift says. "In this case we used sanctions by alluding to the authority of French cooking."

—Kathy Hart

Photo by Steven Wilson



Swift sells his vacuum-packed frozen fish in boxes like these

## Freezing seafood in your home

Blast freezers and carbon dioxide tunnels aren't standard equipment in American homes. So the home freezer may be called on to freeze those 15 pounds of flounder you brought home from your last fishing trip. The key to good home-frozen fish, like the key to good commercially frozen fish, is to start with a fresh fish, one that has been properly handled from the minute it was taken off the line.

Joyce Taylor, a marine advisory agent at UNC Sea Grant's NCSU Seafood Laboratory in Morehead City, says fish you want to freeze should be coated with a glaze to guard against freezer burn and oxidation. Freezer burn changes the texture of the fish, and oxidation, the interaction of oxygen with fish fats, can cause bad odors and flavors.

To prepare the glaze:

—Measure ¼ cup of lemon juice into a pint container. Fill the rest of the container with water.

—Dissolve one packet of unflavored gelatin in ½ cup of the lemon juice-water mixture.

—Heat the remaining liquid to boiling.

—Stir the dissolved gelatin mixture into the boiling liquid.

—Cool the mixture to room temperature.

Dip the fish into the glaze and drain it for several seconds. (The glaze will be enough for about a dozen medium-size fillets.)

Wrap the fish in a saran-type wrap, label and date the package and place it in the coldest part of your freezer. Taylor suggests freezing seafood in small portions so it will freeze faster with less deterioration.

Lean fish such as flounder, snapper and trout can be safely stored in the freezer three to six months. Fatty fish such as bluefish, mackerel and mullet should not be stored for more than three months.

Taylor says shrimp are best frozen in their shells in strong plastic bags. Scallops should be shucked and frozen in air-tight containers. Clams and oysters are best frozen in their shells, which makes for easy shucking and no loss of juices; but they can be shucked and frozen in air-tight containers too. Taylor warns against freezing crab meat already picked from the shell, because it loses its texture and flavor. She suggests freezing the core of the body and the pincers after the crab is cooked, then picking out the meat when it thaws.

When thawing frozen fish or shellfish, Taylor says, never leave it at room temperature. Seafood is best thawed by placing it under cold running water for 15 to 20 minutes.

For more information about freezing fish at home, write for UNC Sea Grant publications, *Don't Waste that Fish* (UNC-SG-75-23) and *Bringing the Catch Home* (UNC-SG-78-05).



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



Reporters, students and hurricane experts gathered May 10 and 11 in Raleigh for a two-day program, "Hurricane Preparedness: A Community and Family Responsibility." The program, organized by John Sanders, Sea Grant's coastal weather awareness specialist, included a workshop for the media. It drew representatives from television stations, radio stations and newspapers from North Carolina and Virginia. Another training workshop was designed to strengthen the working relationship of government agencies responsible for emergency response. County commissioners, public safety officers, emergency management coordinators, building inspectors, city councilmen and other key government officials attended. Workshop participants saw a film on Hurricane Hazel, and heard lectures by several experts, including Neil Frank, director of the National Hurricane Center.

During the program, students from the Science Club of Pamlico Junior High School got some practice in hurricane evacuation. At the American Red Cross headquarters, they set up an emergency shelter, complete with survival boxes and hurricane-safety checklists. The students even spent the night in the shelter—with Sanders and their teachers—to simulate "braving the storm."

What do you do if a hurricane warning is given for your area? Are you prepared to evacuate? Do you

know how to safeguard your house and property during evacuation? For answers to these questions and many more, plan to visit the three N.C. Marine Resources Centers for Hurricane Awareness Week, the first week of August.

The week-long program will feature films, exhibits and lectures on hurricane preparedness and storm-resistant construction. There will even be folk stories for children. Each of the centers will also have a news media workshop on emergency management and hurricane preparedness. John Sanders, Sea Grant's coastal weather awareness specialist, will visit each of the centers during the week, to participate in several programs and lectures.

For more information on the program and on other activities at the centers this summer, write: N.C. Marine Resources Center/Roanoke Island, P.O. Box 967, Airport Road, Manteo, N.C. 27945; N.C. Marine Resources Center/Bogue Banks, Atlantic Beach, N.C. 28512; N.C. Marine Resources Center/Fort Fisher, Kure Beach, N.C. 28449.



Crabs steer clear of a crud-clogged crab pot. And cleaning marine growth from pots is a chore no crabber looks forward to. A new anti-fouling paint, however, may work where other products have failed.

Bob Hines, a Sea Grant marine advisory agent at Bogue Banks, will test the anti-fouling paint this summer in a Sea Grant mini-grant project. Hines plans to set out 40 crab pots, comparing the fouling rates of treated and untreated vinyl-coated and galvanized pots. Catch records will also be kept, to see which pots attract the most crabs.

Hines says a Maryland Sea Grant study indicated that the anti-fouling paint significantly reduced fouling and extended crab pot life. The fouling rate of the painted pot was 83 percent less

than the vinyl-coated pots, which most crabbers in North Carolina use. Catch figures also indicated that the pots treated with the anti-fouling paint, which has tributyl tin oxide as an active ingredient, caught more crabs. Hines wants to see if he can get the same results in North Carolina.

Part of the mini-grant project will include demonstrations of the new product. Chester Cooper, a Columbia crab pot manufacturer who is using the paint, will talk to the crabbers about the paint and will treat some of the pots brought to the meetings. The demonstrations will be held in Pamlico and Carteret counties at the end of June. For more information, contact Bob Hines or Larry Giardina at the N.C. Marine Resources Center at Bogue Banks. Their number is (919) 726-0125.



After serving for one year as president-elect of the Sea Grant Association, UNC Sea Grant Director B. J. Copeland will assume the association's presidency during Sea Grant Week in Washington, D.C., July 19-22. Copeland succeeds Feenan Jennings, director of Texas A&M Sea Grant. The Sea Grant Association unites the numerous state Sea Grant programs along with others to create a strong national voice on issues involving marine problems.

Faculty members from six North Carolina universities have asked for a total of \$4.2 million to conduct Sea Grant research during 1983 and 1984.

Forty-four proposals, submitted in May, now face reviews at four levels. Proposals deemed worthy by reviewers will be included in UNC Sea Grant's funding proposal to the Office of Sea Grant in Washington, D. C.

Dirk Frankenberg, director of the Marine Science Program at the University of North Carolina at Chapel Hill, has been named coordinator of UNC Sea Grant's coastal studies sec-



tion. He replaces Jay Langfelder, who is on leave from North Carolina State University, to serve as assistant secretary of the N. C. Department of Natural Resources and Community Development.



If you're heading to the beach, take along UNC Sea Grant's "How to" series. *How to Hang a Gill Net*, written by Jim Bahen and Mary Day Mordecai, tells how you can make a gill net, saving about half the cost of one ready-made.

*How to use Eels as Bait*, written by Leon Abbas and Mary Day Mordecai, explains how to rig eels for boat and pier fishing, bottom fishing, trolling and freshwater fishing. It also describes how to transport and care for bait eels.

*How to Build a Crab Pot*, written by Kathy Hart, provides a step-by-step description of putting together a crab pot. The booklet also explains the regulations governing the use of crab pots for recreational fishing.

For copies of these publications, write UNC Sea Grant, P. O. Box 5001, Raleigh, N.C. 27650-5001. All the booklets are free.



UNC Sea Grant researcher Mark Sobsey and his graduate students at the University of North Carolina at Chapel Hill are continuing to unfold the mysteries of contaminated shellfish.

Under Sobsey's direction, Anne Meinhold has taken a close look at the elimination of poliovirus in contaminated oysters. She found that at lower water temperatures—between 43°F and 63°F—poliovirus is eliminated primarily through waste elimination and pseudo-feces. Pseudo-feces are particles the oyster draws in, but rejects as unsuitable to eat. As the thermometer rises, poliovirus, which is susceptible to higher temperatures, is made inactive by heat.

Meinhold says that at the lower temperatures the poliovirus is eliminated slowly by the oysters, while at the higher temperatures the elimination is much faster.

While Sobsey and his students may have learned a little more about poliovirus, there are many other viruses that can contaminate shellfish. Sobsey says that next his laboratory will study the elimination of bovine rotavirus, which causes gastroenteritis.



*Design and Installation of Low Pressure Pipe Waste Treatment*, written by Craig Cogger, Bobby L. Carlile, Dennis Osborne and Ed Holland, is a manual designed for use by sanitarians, contractors, architects and engineers. The low pressure pipe system (LPP) is a modified septic system, created for use in soils not suitable for on-site sewage disposal by conventional septic systems. It was developed in a Sea Grant research project led by Carlile.

The manual specifies the procedures and materials to be used for the successful siting, design, installation and maintenance of residential LPP systems.

For a copy of the manual, write UNC Sea Grant. Ask for publication UNC-SG-82-03. The cost is \$2.50.

Note: The Southeastern On-Site Wastewater Treatment Conference, originally scheduled for April, has been rescheduled for Sept. 28-30 at North Carolina State University's McKimmon Center in Raleigh. For more information, write Dennis Osborne, NCSU Department of Soil Science, Box 5907, Raleigh, N.C. 27650.



Project CAPE (Coastal Awareness in Public Education), a marine education project of the Dare County Schools, has two new publications available for educators to purchase. *Navigation* introduces fifth-and sixth-grade students to the world of celestial navigation, to the everyday lives of sixteenth-century sailors, and to modern navigational equipment. *Wanchese Harbor—Community Development* is designed for junior high social studies and science students. The unit uses a seafood industrial park as an example of community planning and introduces students to the business of commercial

*Continued on next page*

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, Box 5001, Raleigh, N.C. 27650.

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To help us specialize our services, please answer these questions.

I am in the following line of work:

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| <input type="checkbox"/> Commercial fishing     | <input type="checkbox"/> Mass media                      |
| <input type="checkbox"/> Educator               | <input type="checkbox"/> Seafood processing/marketing    |
| <input type="checkbox"/> Farming                | <input type="checkbox"/> State government                |
| <input type="checkbox"/> Homemaker              | <input type="checkbox"/> University professor/researcher |
| <input type="checkbox"/> Lawyer                 | <input type="checkbox"/> Other _____                     |

Coastal property owner ☐ yes ☐ no Boat owner ☐ yes ☐ no



fishing. For more information about the units, write Project CAPE, Dare County School Board, P. O. Box 640, Manteo, N.C. 27954.

Rodney T. Gross, an arts and technology major at Elizabeth City State University, has received a \$1000 stipend from UNC Sea Grant to work as an intern at the Marine Resources Center in Manteo. Gross will build exhibits and sharpen his photography skills as he learns more about the marine environment. The internship is part of a Sea Grant program designed to recognize and assist talented students at predominantly black institutions.



A little bit of sun can be healthful, but too much may be dangerous. Jim Patterson, a University of North Carolina dermatologist, says the sun can cause serious skin damage, the worst of which is skin cancer.

Prime candidates for skin damage and skin cancer are people who spend long hours in the sun with little or no protection. Fishermen fit this description, and they may even be getting a triple dose of trouble because of the reflective quality of the water and the fair skin common among the fishing families in this state.

The threat of skin damage and skin cancer can be reduced, however, with protective clothing, sunscreen and less exposure to the sun. To find out more about protecting yourself from the

damaging rays, write for Sea Grant's free Blueprint, "Skin Cancer and Fishermen." To receive a copy, write Sea Grant, Box 5001, Raleigh, N.C. 27650-5001. Ask for publication number UNC-SG-BP-81-6.

Another Sea Grant blueprint, *The \$10 Holding Tank*, is aimed at small-boat owners. The U.S. Coast Guard now requires boats operating within three miles of shore to be equipped with sanitizing gear or onboard holding tanks. Both are expensive items for recreational boaters. But Spencer Rogers, Sea Grant's coastal engineering specialist and a sailboat owner himself, has come up with a low-cost alternative.

*The \$10 Holding Tank* describes the materials needed and gives instructions for assembling the portable onboard holding tank. The holding tank, which can be attached to an existing head, is light enough to be carried home and emptied at the end of the day. For a free copy of this Blueprint, request number UNC-SG-BP-80-1.



Ever see a blue crab take it off? Hundreds of crabs are going to be shedding their old shells this summer in a new outdoor exhibit at the Marine Resources Center on Roanoke Island.

Hughes Tillett, a Sea Grant marine advisory services agent, and Rhett White, director of the center, used a Sea Grant mini-grant this year to construct the exhibit. Two large shedding

trays, filled with water pumped in from the sound, have been set up for the crabs. Displays nearby explain the shedding process.

The exhibit will not only give the public a chance to watch crabs during their natural molting cycle, but it will also serve as a model for new commercial crab-shedding operations. Their product? The prized and delectable soft-shell crab.

A series of video tape programs about business management for commercial fishermen is available at the Sea Grant Marine Advisory Services office at the N.C. Marine Resources Center at Bogue Banks. The tapes feature Fred Smith, a marine economist at Oregon State University. The topics are: Profit: What is it? (30 minutes); Decisions (32 minutes); Risk in decision-making (19 minutes); Financial analysis (32 minutes) and Record-keeping (26 minutes).

Individuals or groups wishing to view the tapes can do so by calling 726-0125.

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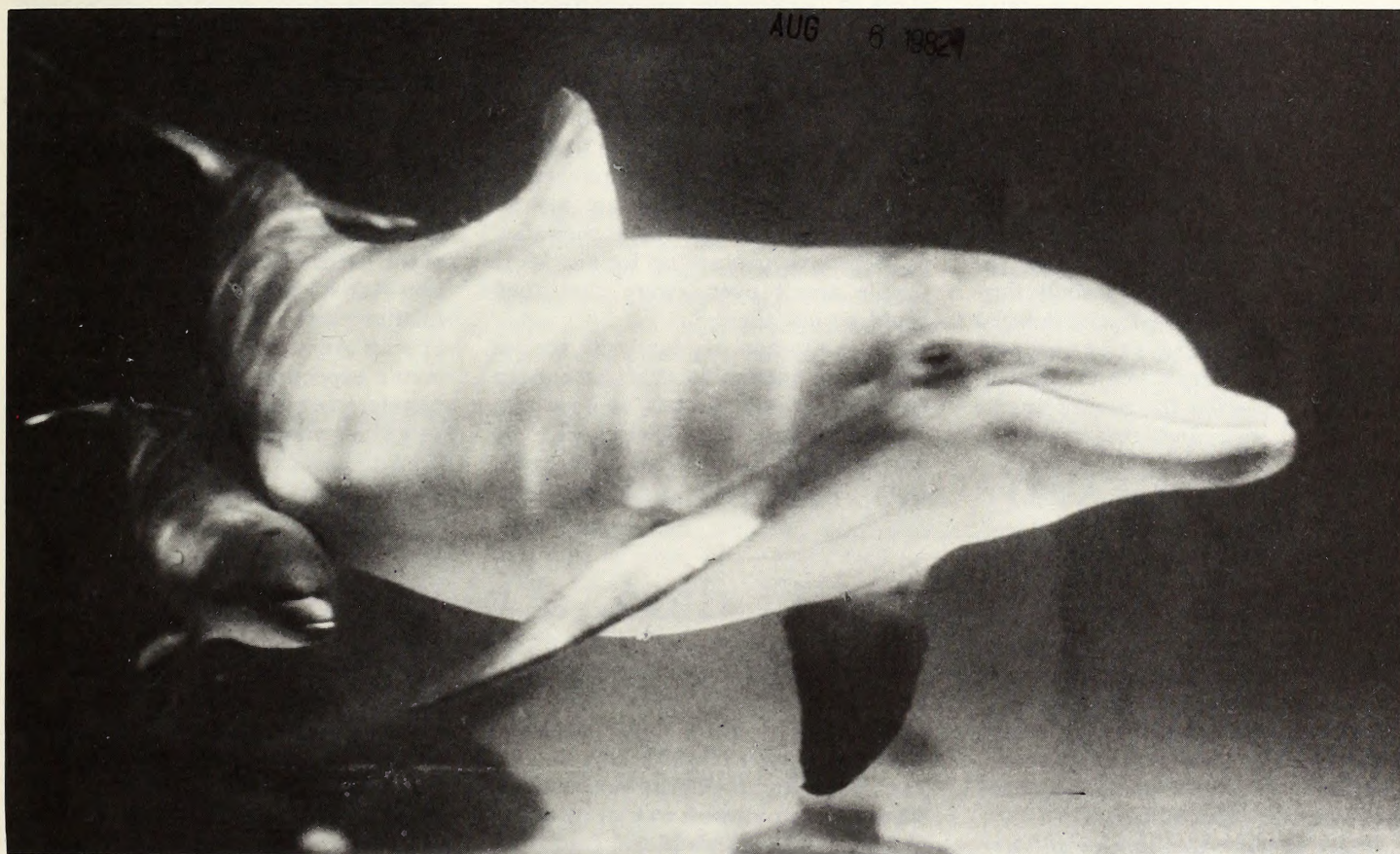
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# COAST WATCH



*Atlantic bottlenosed dolphin and calf*

## Mammals of the sea

Millions of years ago, they emerged from the sea as amphibians and made the land their home. These fish-like creatures who roamed the earth on four legs evolved into mammals, air-breathing and warm-blooded. They bore their young alive and nursed them. Then, over 50 million years ago, some of them returned to the water as mammals and took the rivers, sounds and open ocean for their home.

Marine mammals underwent many changes to adapt to a watery environ-

ment. Their front legs became flippers, and their rear legs disappeared with only small traces of bone remaining in the skeletal structure. Bodies became more streamlined, reducing turbulence and resistance when they moved through the water. Blowholes on the top of the head allowed them to breathe while swimming. They came to resemble large fish, but they were true mammals.

Today there are three groups of marine mammals: cetaceans (whales,

dolphins and porpoises); pinnepids (seals, sea lions and walruses) and sirenians (dugongs, sea cows and manatees). Marine mammals range in size from the blue whale (about 90 feet in length) to the harbor porpoise (about five feet long). Some species, such as the manatee and bottlenosed dolphin, live close to shore while most of the big whales live 30 miles offshore or even farther.

*Continued on next page*



"North Carolina has an extremely impressive array of marine mammals because of latitude," David Lee says. Lee is the curator of birds and mammals at the North Carolina State Museum of Natural History in Raleigh. He says the state's waters have some species that are migratory, some that are permanent residents, and some that reside here only in winter or in summer.

"It wouldn't be accurate to list species native to the state," Lee says, "because many are migratory. Besides, they live underwater and we can't see them, so we don't know much about them." (See page 6 for a list of marine mammals reported in the state.)

The manatee is one species that has managed to go unsighted in recent years. Historical reports as late as the early 1900s indicated that the manatee regularly migrated to the southern coast of North Carolina from Florida during the summer. But heavy exploitation of the meat, especially during the Depression, drastically reduced the population. Lee says there are now about 1,000 manatees left in the United States, placing the species on the endangered list and under federal protection.

"During the summers of '75 and

'76," Lee says, "we (the museum) participated in a cooperative program with the U.S. Fish and Wildlife Service to determine the current status of the animal in North Carolina. We postulated that manatees still occurred in lower numbers in the Cape Fear estuary and in even lower numbers a little further north, like Beaufort." Information resulting from the search indicates that this marine mammal may still occur in the state's waters from June to early October, but no population estimates have been made.

Sightings of manatees aren't easy to come by because the animals frequent the murky waters found in estuaries and along the shore. "The last documented manatee (outside its native Florida waters) was found dead in the Chesapeake Bay," Lee says. "It swam through North Carolina waters, but no one saw it. They are just so hard to see in the water, and then they only stick their noses up for air. Most people aren't even aware that they could be out there."

There are approximately 30 species of marine mammals that have been reported in the state's waters, according to Lee. Some species, like the northern hooded seal, are rare here, while harbor seals occur regularly

along shore. Chances of seeing the big whales offshore are very limited though. "You might see some pilot whales and dolphins," Lee explains, "but even in a big boat offshore, you can't cover that much ocean, and the water is often too rough to see. Our knowledge of abundance of these mammals is based on what we do see and what gets stranded."

Scientists here and around the world are trying to uncover more information about the species and populations of marine mammals. Many of these populations have declined. Gone are the days of big whaling camps along the Outer Banks and New England. The International Whaling Commission, which was formed in 1946, has in recent years lowered kill quotas of some species and put bans on killing other species.

In the United States, all marine mammals come under the jurisdiction of the federal Marine Mammal Protection Act of 1972, and the manatee is further protected by the Endangered Species Act of 1975. While scientists aren't expecting populations to completely recover, they are trying to ensure that enough mammals survive to keep the species and research alive.

—Cassie Griffin

## Strandings: A source of data, a biological mystery

There are huge gaps in man's knowledge of marine mammals. These diverse and mysterious sea creatures spend most of their lives underwater, making observations and most standard research work difficult.

Oddly enough, the bulk of information available on marine mammals comes from dead specimens, not living ones. Scientists study strandings to learn about feeding habits, the rates and causes of natural mortality, breeding and populations. Skeletons, brains, and other valuable parts of the animal are preserved for research.

The first studies of marine mammal strandings took place at the Smithsonian Institution in Washington, D.C. Whale scientist Frederick W. True circulated a letter to lighthouse keepers, light stations and lifesaving stations asking them to notify him of strandings. True kept records of this information and, when he could, salvaged the remains for his research.

His work lasted from the early 1880s until 1914.

From 1914 until 1972, data on strandings was collected only in bits and pieces by zoologists and universities with an interest in marine mammals. In 1972, James Mead, curator of the Division of Mammals at the Smithsonian, set up the Marine Mammal Salvage Program.

"The program has two aspects," Mead says. "First, we set up a network of people who have regular access to the coast, and we got them to call us with notification of a stranding. Secondly, we developed a way to go and get data from the animals, which provides a source of data for research and for the museum's collection."

In the beginning, the program covered strandings from Cape Cod to Charleston, South Carolina. In recent years, four active organizations have picked up most of the work north of Washington, D.C. and the program

now concentrates its work force of two (Mead and Charley Potter) on Maryland, Virginia and the North Carolina coast as far south as Ocracoke. (David Lee of the State Museum of Natural History is responsible for compiling records on the remaining coastline.) Potter and Mead say they will travel anywhere in the world, though, for a rare species.

Mead, who has personally covered 400 of the 1,500 strandings since the program began, has been collecting theories on why marine mammals strand. One of the first big theories involved worms in the mammal's ear. Because marine mammals depend on sound for determining sense of direction, it was thought that the worms caused the mammals to stray off course and strand. This theory lost credence when later strandings revealed no worms present in the mammals. Mead says that some people also believe that since cetaceans were



derived from land animals, there is a subconscious behavioral pattern to return to the land and lie down to rest.

Another theory deals with continental drift. Scientists postulate that cetaceans have in their subconscious some memories of past migration routes. When put under any kind of stress, those memories surface, and the marine mammals try to follow a path that would have been open 10 million years ago. But now it is blocked by a continent.

However, Mead thinks a more plausible and simple explanation for the strandings is not a single reason, but a combination of reasons. Animals are led out of their normal distribution pattern and put under some kind of stress. "I feel that a marine mammal is not used to physical barriers," Mead says. "They don't understand that the ocean has sides and a bottom. They just don't recognize the beach as a barrier that will impede them." Mead says more information is really needed on what caused the animals to diverge

from their normal patterns in the first place.

Research has provided some insights into strandings. Lee says individual strandings usually involve sick, injured, tired and weak specimens that are brought in by the current. "Sometimes a porpoise and her calf will strand together," he says, "because one is sick and the healthy one is staying with the other."

Mass strandings seem to be more

preserved for future research. It's not a job for the weak or those with weak stomachs. "Once when we were salvaging a thirty-foot, small humpback," Lee recalls, "it took six of us, after we cut off a fin, to lift it and put it in the truck. That fin was big and slimy with no handles." After data are collected, carcasses are either buried or towed out to sea for disposal.

Al Swanson, a taxidermist from Powell's Point, is one of the authorized

*"We know very little about them biologically—when they reproduce, when they migrate, how fast they grow, how long they live. Even on the most common species, the specimens are valuable."*

*—David Lee*

complex and can involve from several to several hundred animals. Such strandings may result from a reaction to fear, bad weather conditions, herd diseases or physiological problems that reduce the animals' effectiveness and survival. Potter says there is a tight social bond among members of species that strand in masses, and that mass strandings can be triggered by a catastrophic event in which species follow the leader of the herd. "Mass strandings also involve primarily offshore species," he says, "such as pilot whales, killer whales, sperm whales, rough-toothed dolphins and many-toothed blackfish."

Pilot whales were the victims of the last big stranding in North Carolina. In October 1973, 50 of the whales, averaging 17 feet in length, stranded at Cape Lookout. Cape Hatteras is known as the "Graveyard of the Atlantic" for whales as well as vessels, according to Lee. Strong currents can trap weakened or confused animals, which end up on the Outer Banks.

In a given year, Lee says, they record 30 to 250 strandings. "The reason the number varies," he says, "is because strandings vary from year to year and the reporting input varies. Probably less than thirty percent of all strandings get reported."

So, what happens to the stranded marine mammal? Depending upon the species, staff from the Smithsonian, the state museum or area contacts with authorization will go down to the beach and survey and record the event. Autopsies may be performed and the carcass stripped and parts

area contacts Lee calls to check out strandings on the Outer Banks. He goes down to the beach, gathers the basic data on the animal and calls in the report to Lee, who may ask Swanson to freeze the carcass until he can get down to see it. But, Swanson has another role in the salvage program.

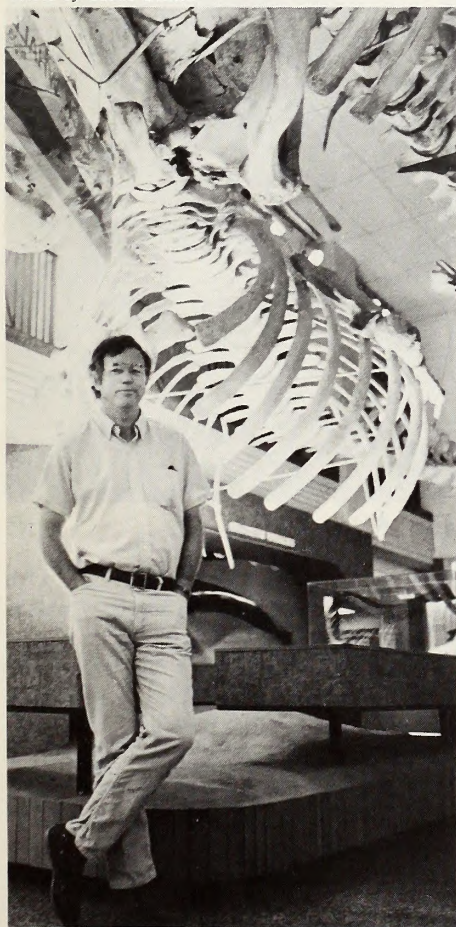
"If it's a species the museum needs," he says, "I will make a fiberglass casting of it with the same techniques I use to make reproductions of saltwater sport fish." In the past two years, he has made castings of a harbor porpoise, a pilot whale, a bottlenosed dolphin and male and female grampus, which are hanging in the museum.

Lee says it is important to have specimens preserved in some manner. "We like to make sure the specimen ends up in an appropriate place, such as teaching collection at a college or university, an exhibit in a marine resources center, the Smithsonian or the museum here," he says. "It's important that the animal and its parts get saved, so that later, when someone wants to study them, they know where they can find, say, fifteen specimens of pygmy sperm whale females collected in January. Even the most common species, we know very little about them, biologically—when they reproduce, when they migrate, how fast they grow, how long they live—things like that. Even on the most common species, the specimens are valuable."

Or, as Charley Potter explains, "That's why we spend so much time mucking around in these carcasses."

*—Cassie Griffin*

Photo by Cassie Griffin



*David Lee and sperm whale skeleton in the museum*



# If you find a stranded marine mammal . . .

Photo by Hilda Livingstone

**Fact:** There is a marine mammal stranding along the North Carolina coast nearly every week. While the bottlenosed dolphin is the most common species, whales occasionally wash up, and, even less frequently, a seal or two. Stranded animals may be alone or in a group, dead or alive, but most still provide valuable sources of information in marine mammal biology. What do you do if you find a stranded marine mammal?

First, you should be aware that marine mammals come under the jurisdiction of the federal Marine Mammal Protection Act of 1972. Under its provisions, it is unlawful for anyone without a permit to handle, harass or possess any marine mammal, dead or alive, and there are stiff fines and possible imprisonment for violators. Agencies or institutions with legal responsibility should be notified. David Lee of the State Museum of Natural History and Charley Potter of the Smithsonian Institution's Marine Mammal Salvage Program suggest the following steps:

## What is it?

Before you notify the authorities, gather as much information as possible on the stranding without handling the animal. Is it a shark or a mammal? Sharks have vertical tail fins, and whales have horizontal tail fins. Is it a mass or individual stranding? Is it a seal, manatee or whale (including dolphins and porpoises)? Is it a toothed whale or a baleen whale? Toothed whales have a single blowhole; baleen whales have two. If it is a toothed whale, how many teeth are present on the upper and/or lower jaw? (Do not attempt this search if the animal is still alive.) What is the shape of the head? Are there any obvious color markings? Estimate the length either by measuring or by walking off the length of the animal. For seals, note color and texture of fur or hair, presence or absence of external ear flaps and length of the animal. Finally, is the animal dead or alive?

David Lee, who is working on a book now with James Mead on marine mammals and strandings in North Carolina, suggests estimating the length as closely as possible. "If it's over a certain number of feet, we can



*Grampus stranding at Nags Head Beach, February 1981*

immediately rule out that it's a bottlenosed porpoise, which is the most common stranding," he says. "If you knew the length and reported whether it had teeth or not, and then if you really had time and could count how many teeth it had and which jaws they were in, we could probably guess within one or two species what it is. And, if we knew the color, we could probably rule out one of those and make an intelligent guess."

## Where is it?

It is extremely important to deter-

mine the exact location of the stranding site. When calling to report a stranding, be sure to describe the location so accurately that someone can find it, even in the dark if necessary. Precious hours may be lost if the location is not accurately pinpointed. How accessible is the stranding site? Is a boat necessary or can it be reached by a four-wheel-drive vehicle or an ordinary car?

## Whom do I call?

There are biologists, government agencies and knowledgeable contact



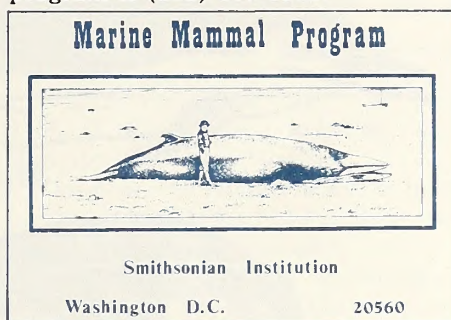
people designated as part of a network to cover strandings along the North Carolina coast. Whom you call depends on where you are. The beaches of Cape Hatteras National Seashore, Pea Island National Wildlife Refuge, and Cape Lookout National Seashore are under federal jurisdiction. Contact the park service staff immediately at these telephone numbers with the information you have gathered on the stranding: Cape Hatteras (919) 473-2117, Pea Island (919) 987-2394 and Cape Lookout (919) 728-2121.

If the stranding is on state property, contact the National Marine Fisheries Service (NMFS) office in Morehead City at (919) 728-4595. NMFS is the government agency with legal authority over marine mammals.

The Southeastern United States Marine Mammal and Sea Turtle Salvage Network notifies area agencies and biologists for every stranding reported to their toll-free number: 1-800-327-6545.

While it is important to contact the Smithsonian Institution's Marine Mammal Salvage Program, Potter suggests you first contact agencies closest to the stranding site as they are in a better position to take immediate

action. These agencies will contact the Smithsonian at the first chance. The telephone number for the salvage program is (202) 357-1920.



If, for some reason, you have not been able to reach any of the agencies listed above, call the Coast Guard, state Division of Marine Fisheries, local police department or county sheriff, wildlife department, local Marine Resources Centers (Fort Fisher (919) 458-8257, Bogue Banks (919) 726-0121 and Roanoke Island (919) 473-3493), universities or colleges, area humane society or the Society for the Prevention of Cruelty to Animals.

Remember to leave your name and phone number in case the agencies you have called need to reach you for more details on the stranding.

What to do until help comes —

In the event that nobody is able to respond immediately, follow any instructions given by telephone. The following steps should also be taken:

If the animal is still alive, be cautious for your own protection. Live animals should be kept wet and protected from the sun. Cover with wet blankets, but keep the blowhole area open. If there is sun, shade the animal with a lean-to made of driftwood, towels or any other material that is handy. Ice packs may be applied to flippers, dorsal fins and flukes to help prevent overheating. Do not try to move stranded marine mammals, either dead or alive. And, above all else, protect the animal from harassment or mutilation by other animals or by crowds.

David Lee offers a warning and a bit of common sense tempered by experience in dealing with marine mammal strandings: "Almost all marine mammals that are on the beach are going to die in spite of what you do for them. And, if you lug them out to sea, you're just prolonging their agony, and they're just going to wash up somewhere else."

## A museum specimen

*In 1928, a 55-foot sperm whale stranded at Wrightsville Beach. It took seven people seven days to flesh down the carcass and bury it. After a year, the skeleton was unearthed and transported to Raleigh where the bones were spread out on the roof of the Agriculture Building to bleach in the sun. Many months and staff hours later, the skeleton was put back together and hung in the museum where it has been on exhibit for 50 years.*

*Photos courtesy of the N.C. State Museum of Natural History*



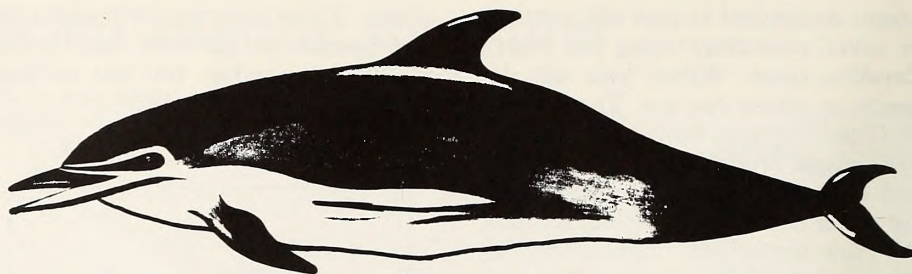


# Dolphin Or porpoise?

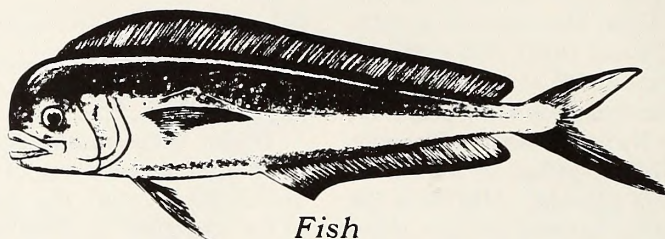
There has been a small controversy going on in the scientific world for years. Dolphin or porpoise . . . which word do you prefer to use when referring to the small marine mammal?

Basically, all cetaceans are whales, though "whale" most commonly refers to the large species. Some scientists argue that the term "porpoise" should be used for all small whales. Others use "porpoise" only for members of the family *Phocoenidae* and "dolphin" for those cetaceans of the family *Delphinidae*. Common names may vary from locale to locale and from one scientist to another, but the two families are very much alike.

To add to the confusion of names, there is also a marine fish, from the genus *Coryphaena*, known as the dolphin. This fish, which is often caught off the North Carolina coast, grows to a length of six feet and usually stays close to the surface in tropical and sub-tropical seas. The male has a high, bulgy forehead, like



Mammal

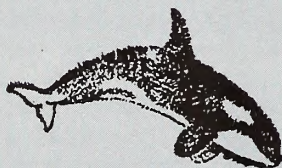
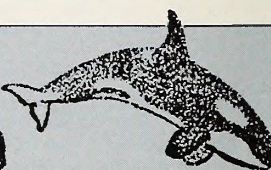
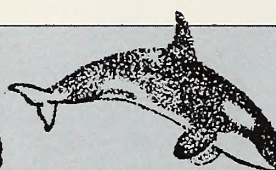
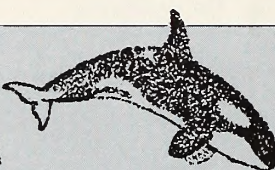
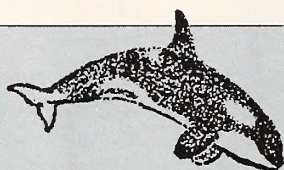
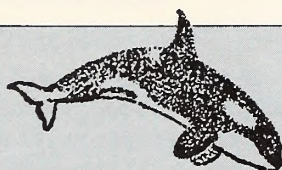


Fish

some cetaceans. However, unlike the air-breathing mammals called dolphins, the fish is completely aquatic and gets its oxygen from the water with gills. The mammal dolphin is warm-blooded while the dolphin fish is cold-blooded. In addition, the tail fins of marine mammals are horizontal; those of all fishes are vertical.

Frank Schwartz, a marine biologist at the University of North Carolina

Institute of Marine Sciences in Morehead City, has his own solution for naming the fish and mammals. "If I use the word dolphin, I think of the fish, being a fish man," he says. "If you say porpoise, I know you're talking about a mammal. But, when you say dolphin, I have to ask if it's a fish or mammal to sort them out. Neither is incorrect," he explains, "it's just a matter of personal preference."



## Marine Mammals Reported In N.C. Waters

Atlantic Right Whale  
Finback Whale  
Humpback Whale  
Sei Whale  
Sperm Whale  
Atlantic Beaked Whale  
Gervais' Beaked Whale

Goosebeak or Cuvier's Beaked Whale  
True's Beaked Whale  
Atlantic Blackfish or Pilot Whale  
Short-finned Blackfish or Pilot Whale  
Grampus or Risso's Dolphin  
Atlantic Killer Whale  
False Killer Whale  
Florida Manatee  
Minke Whale  
Atlantic Bottlenosed Dolphin  
Atlantic Harbor Porpoise  
Common or Atlantic Dolphin  
Cuvier Dolphin  
Rough-toothed or Longbeak Dolphin  
Pygmy Sperm Whale  
Spinner Dolphin  
Spotted Dolphin  
Striped Dolphin  
Harbor Seal  
Hooded Seal

*Eubalaena glacialis glacialis* Muller  
*Balaenoptera physalus* Linnaeus  
*Megaptera novaeangliae* (Borowski)  
*Balaenoptera borealis* Lesson  
*Physeter catodon* Linnaeus  
*Mesoplodon densirostris* (Blainville)  
*Mesoplodon europaeus* Gervais  
(= *M. gervaisi* (Deslongchamps))  
*Ziphius cavirostris* G. Cuvier  
*Mesoplodon mirus* True  
*Globicephala melaena melaena* (Traill)  
*Globicephala macrorhyncha* (Rice)  
*Grampus griseus* G. Cuvier  
*Orcinus orca* Linnaeus  
*Pseudorca crassidens* Owen  
*Trichechus manatus* Linnaeus  
*Balaenoptera acutorostrata* Lacepede 1804  
*Tursiops truncatus truncatus* (Montagu)  
*Phocoena phocoena* Linnaeus  
*Delphinus delphis delphis* Linnaeus  
*Stenella frontalis* G. Cuvier  
*Steno bradanensis* Lesson  
*Kogia breviceps* (Blainville)  
*Stenella longirostris* (Gray)  
*Stenella plagiodon* (Cope)  
*Stenella ceruleoalba* Meyer  
*Phoca vitulina concolor* DeKay  
*Cystophora cristata* (Erxleben)



# THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).



Students in a design class at NCSU have spent the summer grappling with a tough problem: How do you convince picky eaters to try unusual seafoods?

In a summer studio class conducted by associate professor Austin Lowery, the students have designed logos, advertisements, posters and even T-shirts as part of a "campaign" to promote five under-used North Carolina seafoods—shark, squid, eel, skate and ray.

The project, which was organized by Lowery and Neil Caudle, Sea Grant's director of communications, gives the students practice solving some practical design problems. One goal of their work is to convince their fellow students to try, say, skate creole or smoked eel. The materials will also be useful in some of Sea Grant's education programs.

The students have had help with their research. Two Sea Grant seafood experts, Joyce Taylor and Sam Thomas of the NCSU Seafood Laboratory in Morehead City, supplied the class with facts about seafood nutrition, preparation and marketing. The students even had a chance to sample their subject matter. Lundie Spence, Sea Grant's education specialist, helped them prepare shark-kabobs and fried squid. Their reaction? "Delicious!"

Want to try some unusual seafoods for yourself? Plan to be in Beaufort August 19 for the sixth annual Strange

Seafood Exhibition, held by the Hampton Mariners Museum.

This year, the exhibition will be held for three hours, from 1 to 4 p.m., at the museum's Heritage Boatshop on Turner Street, says Judith Spitsbergen, education coordinator for the museum. A \$2 admission fee will be charged to cover the cost of the seafood.

Spitsbergen says 60 to 70 volunteers from Carteret County and beyond will be cooking and serving 40 different dishes, including stingray casserole, herring roe and eggs, eel salad, fried squid and marinated octopus. Sea Grant staff at the NCSU Seafood Laboratory in Morehead City will be smoking fish or eel for the exhibition, says Sam Thomas of the lab. The plans also call for demonstrations on how to clean and prepare seafood for cooking.

All of the recipes used to cook the dishes will be included in the Strange Seafood Cookbook, which will be available at the exhibition for \$5 a copy.

Last year, 1200 to 1500 people attended the event and Spitsbergen says more are expected this year. After a national television spot featured the exhibition, calls poured into the museum for a schedule of this year's events.



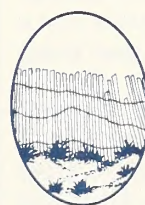
Emptying sewage may not be top priority in every boatowner's mind, but someone has to do the dirty work. To make that job easier, Sea Grant has just published a new Blueprint.

A *Portable Transfer Tank for Boat Waste* is designed for owners of boats with holding tanks. Although Coast Guard regulations require pumpout of this waste, very few marinas have the expensive commercial systems that can do the job. This Blueprint describes a low-cost alternative that can be put together in an afternoon for less than \$250.

Written by Spencer Rogers, Sea Grant's coastal engineering specialist, this illustrated leaflet gives a list of

materials and step-by-step instructions for constructing the transfer tank. Rogers is also the author of another Blueprint, *The \$10 Holding Tank* (UNC-SG-BP-80-1).

To obtain a free copy of *A Portable Transfer Tank for Boat Waste*, write Sea Grant. Ask for publication number UNC-SG-BP-82-1.



Every coastal dune needs roots to survive. Dune vegetation not only stabilizes the surface, it also traps new sand and puts erosion on hold. To build or repair dunes on coastal property, owners need only basic gardening tools and a little time for planting and maintenance.

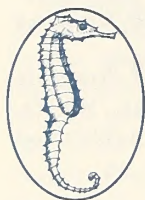
Sea Grant's new publication, *Building and Stabilizing Coastal Dunes with Vegetation*, provides guidelines for property owners interested in this natural erosion-control method. Specific information is given on the five dune grasses suitable for transplanting along the North Carolina coastline—American beachgrass, bitter panicum, saltmeadow cordgrass, sea oats and seashore elder—from dates and methods for planting to disease resistance. Tips on fertilization, transplanting, maintenance and choosing the right grass for the site are also included.

*Building and Stabilizing Coastal Dunes with Vegetation* is written by S.W. Broome and W.W. Woodhouse, Jr. of the Department of Soil Science and E.D. Seneca of the Department of Botany at North Carolina State University. This publication is the result of research supported by the UNC Sea Grant College Program, North Carolina Agricultural Research Service and the U.S. Army Corps of Engineers. Broome, Woodhouse and Seneca are also authors of another Sea Grant publication on erosion control called *Planting Marsh Grasses for Erosion Control*.

Continued on next page



For a free copy of *Building and Stabilizing Coastal Dunes with Vegetation* (UNC-SG-82-05) or *Planting Marsh Grasses for Erosion Control* (UNC-SG-81-09), write Sea Grant, Box 5001, Raleigh, N.C. 27650-5001. Please include the publication number with your request.



It was the worst storm the trail guide had seen in 20 years of climbing Alaska's Mount McKinley. And Jim Murray was right in the middle of it. The storm ripped his tent to shreds, forced Murray and his nine teammates into a snow cave, and almost took their lives.

Murray, director of Sea Grant's marine advisory services, likes to mix adventure with his vacations. He has climbed before—four peaks in Nepal and several others in the U.S. But McKinley proved to be his toughest climb. Measured from base to summit, it is the tallest mountain in the world.

When the storm struck on May 26, it brought temperatures in the minus 40s and winds of 100 mph. The tents took wing, and Murray and his companions spent 18 hours huddling in a snow cave they dug with their axes. Finally, the storm broke and they climbed down, cold but okay.

"It's a simpler life up there," Murray says of the climb. "Things get right down to the basics of survival. I kind of like that."

His next climb? Africa's Kilimanjaro, two years away.

More in his professional line, Murray was appointed recently to the Council of Sea Grant Directors' Task Force on Marine Advisory Services. The task force will make recommendations on Marine Advisory Services policy.

You're playing in the surf when suddenly you're swept out to sea by a rip current. What do you do?

Rip currents, which are common along some North Carolina beaches, form when water that normally moves along the shore rushes back to sea in a narrow path. These currents can extend as far as 3,000 feet offshore, reach 90 feet in width, and travel up to four feet per second, which is faster than the average swimmer.

If you find yourself caught in a rip current, don't panic and don't try to swim against the current. Swim parallel to the shore until you get out of the current and then swim back to the beach. If you can't get out, float calmly with the current until it dissipates, then swim diagonally to shore.

How do you avoid rip currents? Watch for these telltale signs: a difference in color from surrounding water, a gap in the breakers where the current is moving seaward, or a floating object that moves steadily to sea.

For a colorful poster explaining rip currents, write UNC Sea Grant, P. O. Box 5001, Raleigh, N.C. 27650-5001.

The Office of Sea Grant in Washington, D.C. has decided to no longer conduct site visits at the 16 Sea Grant College Programs. In the past, teams of experts have visited each Sea Grant program yearly or biennially, whether the program had been designated a college or not, to review proposals for funding. Now, Sea Grant Colleges will be undergoing a program review once every three to five years, and proposals will be reviewed in Washington. UNC Sea Grant is a college program and the site visit scheduled for October has been canceled.

After several rigorous reviews the 44 proposals received in May were narrowed to 20 proposals. With some revision, these proposals will be included in UNC Sea Grant's 1983-84 proposal for funding to the Office of Sea Grant later this year.

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*Coastwatch* is published monthly except July and December by the University of North Carolina Sea Grant College Program, 105 1911 Building, North Carolina State University, Raleigh, NC 27650-5001. Vol. 9, No. 7, August, 1982. Dr. B.J. Copeland, director. Neil Caudle, editor. Kathy Hart and Cassie Griffin, staff writers. Second-class postage paid at Raleigh, NC 27611.

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## COASTWATCH

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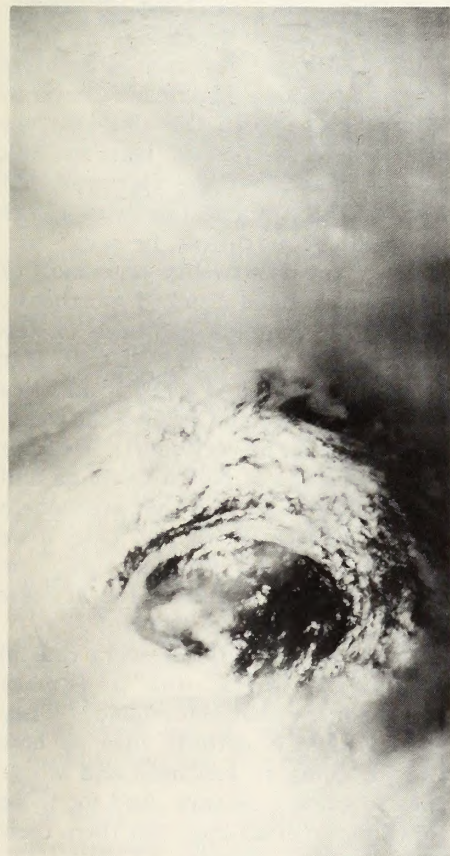


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# COAST WATCH

SEP 16 1982

Photo courtesy of NOAA



*Eye of a hurricane*

Photo courtesy of the Division of Archives and History

## Surviving Hazel, the hard way

The water rose. Dishes crashed and furniture bounced like billiards after a break shot. Connie Helms could feel the water lapping against the ceiling of the first story beneath her.

It was October 15, 1954. Earlier, Hurricane Hazel had been churning in the Caribbean, while Connie and her husband made their way to Long Beach, for their honeymoon. Connie never thought the storm would hurl its weight at North Carolina.

But the rains began, then the winds. Waves broke through the dunes and water covered the main road. The Helms were trapped on the island. They abandoned their one-story cottage for a two-story frame house nearby.

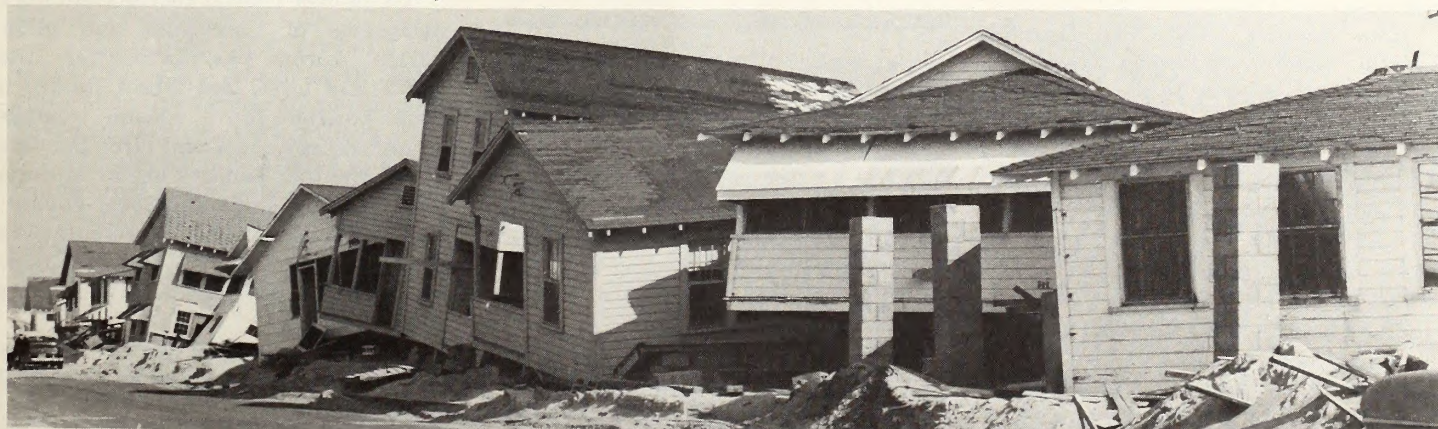
From the second-story windows Connie watched the fury of the hurricane unfurl. Winds ripped some houses apart. Waves toppled cement-block houses as if they were built of toy blocks. Other houses rode the waves, crashing into one another. Whirling winds made flying projectiles

out of boards, furniture and tree limbs.

As the waters rose higher and finally began lapping the first-story ceiling below their feet, the Helms realized their shelter might topple with the next crash of a wave. To escape, they pushed a mattress out of the window into waters that swirled just inches below the second-story window frame. Connie Helms perched herself on top of the mattress. She and her new husband tied themselves together with a flannel blanket. Jerry Helms dropped into the water, catching one corner of the mattress. He pushed the couple away from the house and caught a chunk of floating wall to add buoyancy to the mattress. He knew his 17-year-old bride could not swim.

A lot has happened in Connie Helm's life since that October day in 1954. She is now Connie Ledgett, living in Southport and serving as executive secretary of the Southport/Oak Island Chamber of Commerce. But her memory of

*Continued on next page*



*A row of houses lie toppled like building blocks at Carolina Beach one month after Hazel*



Hurricane Hazel has not dimmed through the years.

"We'd hoped to float to this sand dune that stood between the house and Davis Creek," Connie recalls. "But we didn't count on the winds shifting on the other side of the eye. Instead we were pushed across Davis Creek into the top of some scrub oaks that stood thirty feet off the ground."

After a few hours the waters began to recede. "It was like taking the stopper out of a bathtub," she says. "If we hadn't had those trees to hold on to we would have been sucked out to sea."

After the hurricane had spent its energies and moved on, the Helms climbed from their tree-top perch and began their walk off the island. "The area was totally demolished," she says. "The dunes were leveled. It was like a scene out of one of those nineteen-fifties science-fiction movies."

Living through a hurricane as ferocious as Hazel taught Connie a healthy respect for the storms. She knows she was lucky to live through it; 19 other people didn't. "Being in a hurricane is not a thrill," she says. "People should pay attention to the warnings issued by the National Weather Service. They may not have control over the loss of their property or the savings they have invested in it, but they do have control over saving their own lives."

But there are only a few people like Connie Ledgett—people who have experienced a hurricane—living along the North Carolina coast now. And this worries experts at the National Weather Service and the state Division of Emergency Management. They're afraid large portions of the coastal population, unaware of hurricane hazards, will not respond to hurricane warnings and evacuation notices.

John Sanders, UNC Sea Grant's coastal weather awareness specialist, says as little as 10 to 15 percent of the present coastal population have any prior experience with a hurricane. And, he says, if you allow for tourists, which can increase the population of an area like Atlantic Beach ten-fold, then an even larger percentage of inexperienced people are involved.

Sanders says coastal growth in areas such as Dare, Carteret and New Hanover counties has compounded problems. Dare County's population has doubled since 1960 (North Carolina's last encounter with a major

hurricane). The population for the town of Atlantic Beach has increased twelve-fold. Most of these residents are new to the area and new to the hazards of a hurricane, Sanders says.

In a study Sanders conducted in Myrtle Beach, South Carolina in 1979, people were asked how much they understood about hurricanes. Results showed that 78 percent of those surveyed understood that strong winds accompanied the hurricane; 33 percent

Photo by Gregg Gandy



*"It was like taking the stopper out of a bathtub. If we hadn't had those trees to hold on to we would have been sucked out to sea."*

—Connie Ledgett

were aware of a hurricane's storm surge—the huge waves and storm tides which may reach 25 feet or more as a hurricane moves ashore; 12 percent understood flooding accompanied a hurricane. Yet, Sanders says, nine out of 10 hurricane-related deaths occurred because of drowning and most property damage is caused by the storm surge and flooding.

"The fact that North Carolina has not been hit by a serious hurricane in 20 years is a problem in itself," says Bob Muller, meteorologist-in-charge and area coordinator of the National

Weather Service (NWS) in Raleigh. "The public is apathetic about hurricanes. They haven't come against one so they no longer see them as a threat they need to be concerned with."

During brushes with Hurricane David and Bret, people actually flocked to coastal areas to watch nature's fireworks in action. "I think there is a tendency for people to think Mother Nature is not that cruel," says Al Hinn, meteorologist-in-charge with the NWS in Wilmington. "They don't want to think there is anything so potentially dangerous it could destroy something they've built or themselves."

Gil Clark, a hurricane forecaster with the National Hurricane Center in Miami, says North Carolina is in an area where hurricanes recurve. It's usually between Cape Hatteras and Bermuda that hurricanes swing either northeast or northwest, he says.

"Over the past twenty years most of the storms have tracked northeast, and North Carolina has been on the weak side of the storm," he says. But he points out that if a hurricane were to move into North Carolina the warning time could be very short. "Because of the latitude of North Carolina and because the state is in that area where hurricanes recurve we'd be lucky if we had twelve hours warning time," he says. "And we usually have at least twenty-four hours in the Gulf."

Clark says he advises every coastal family to work out a family preparedness plan beforehand. "They should have a definite idea of how they're going to evacuate and where they're going," he says. And for those unwilling to evacuate, "ask them their next of kin," Clark says. "That usually brings them out."

To booster coastal North Carolina's awareness of hurricanes and other coastal storms, like northeasters, the NWS and UNC Sea Grant funded a joint position for a coastal weather awareness specialist and hired Sanders to fill the job. Sanders began working with federal, state and local government officials, media representatives and local people to increase their knowledge of hurricanes. His activities have included:

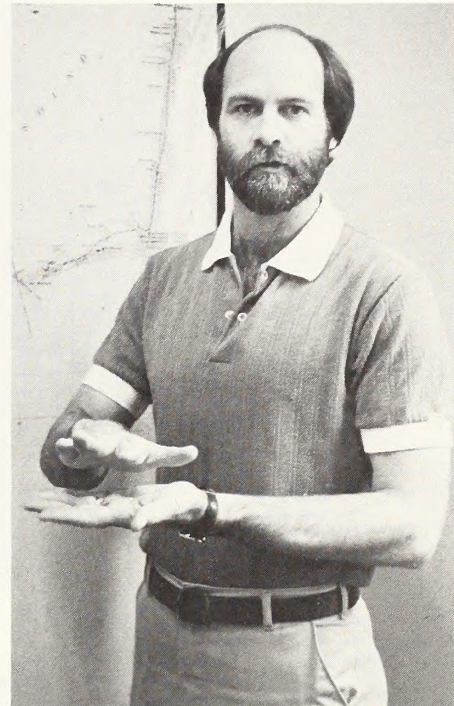
- A series of newspaper columns about hurricanes distributed to coastal newspapers.

- Local workshops and presentations that encouraged individuals and





Front Street in Beaufort as Hurricane Hazel struck in 1954



John Sanders

families to develop hurricane preparedness plans.

- An appearance on "Almanac," a television program produced by the N.C. Agricultural Extension Service, where he explained the destructiveness of a hurricane and how to prepare and respond when one is forecast.

- Schooling broadcast and print journalists along with local emergency management coordinators in a statewide workshop, "Hurricane Preparedness: A Community and Family Responsibility."

- Developing a hurricane safety checklist tailored for North Carolina use.

- Working to coordinate hurricane preparedness efforts between state agencies such as the Department of Emergency Management and Office of Coastal Management.

- Introducing new research and methodologies that will assist emergency management coordinators in developing evacuation plans.

- Developing educational tools that can be used in the public schools to explain what are hurricanes and how to respond if one occurs.

Sanders and Hinn both say the media has been responsive to publishing and broadcasting hurricane-preparedness stories, thus reaching more and more people about the potential dangers of a hurricane. The Marine Resources Centers at

Roanoke Island, Bogue Banks and Fort Fisher each sponsor a "Hurricane Awareness Week" in August every year. Sanders, Spencer Rogers (UNC Sea Grant's coastal engineer), meteorologists from the NWS and emergency management coordinators speak to audiences about hurricanes during the week. The Marine Resources Center at Bogue Banks also

is putting up a hurricane exhibit.

Sanders says he believes more people are increasing their hurricane awareness. "When I go into an area and begin to talk about hurricanes, people seem better able to respond," he says. "And they are taking a more active role in developing hurricane preparedness plans."

—Kathy Hart

## Planning for the inevitable storm

A hurricane is building in the Caribbean. It begins a track northward on a course that marks its landfall as the central North Carolina coast. How do state and local emergency management personnel respond to ensure the public's safety?

Most of the work for evacuation plans was done before hurricane season ever began. The state Division of Emergency Management developed and issued a county prototype evacuation plan seven years ago to the 18 coastal counties. From this plan each county developed its own county evacuation plan. These plans are updated and changed as situations and conditions change in the county.

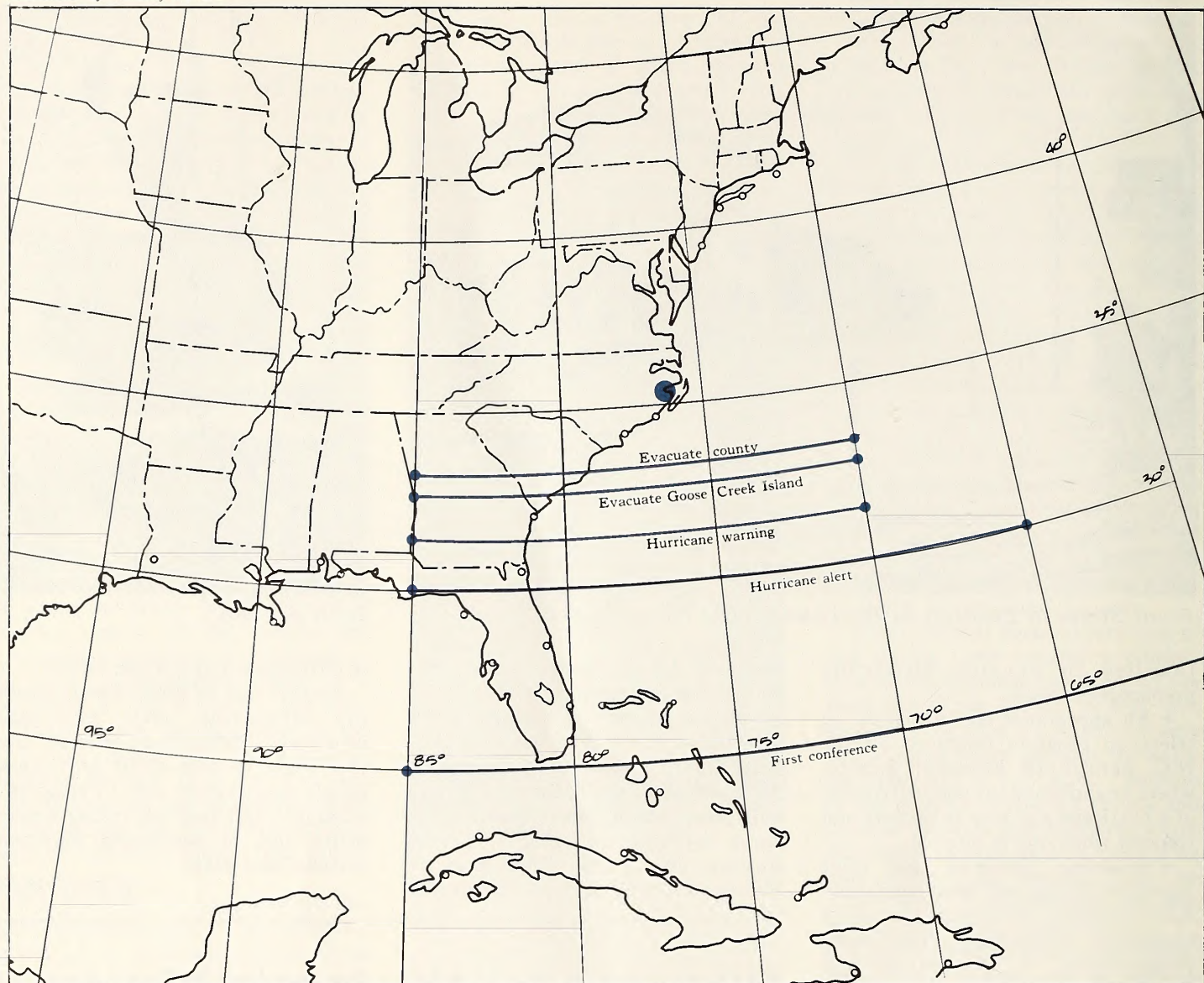
The Division of Emergency Management also developed a state plan that will activate state agencies

such as the Department of Transportation, which controls the coastal ferry and bridge system, and the Highway Patrol, which would assist with traffic control. Emergency Management also is helping industries such as Weyerhaeuser to develop their own hurricane plans.

As hurricane season begins June 1, the state and county emergency management offices go into a "condition five alert" which they will maintain throughout hurricane season. If a hurricane advisory is issued for North Carolina a "condition four alert" would be established. Plans are reviewed and shelters checked. When a hurricane watch is posted (48 hours in advance of possible landfall) a "condition three alert" is set. Sheriff's

*Continued on next page*





*Pamlico County's evacuation plan based on longitude and latitude*

departments, police departments, city mayors, county commissioners, the Red Cross and others are notified. Shelter preparations begin.

"Condition two" begins 24 hours in advance of hurricane landfall. Shelters are opened. Emergency equipment and vehicles are readied. Public advisories are issued.

Twelve hours from landfall "condition one" is established. The order to evacuate beachfront and flood-prone areas is given during condition one. The decision to evacuate may be made by the emergency management coordinator, as is the case in Pamlico County, or by an emergency committee of county mayors and county commissioners, as in New Hanover County. The decision is made at the county level, not the state level.

During this condition one phase, a central emergency headquarters is established. Orders go out from the headquarters to police, the sheriff's department and the fire department for the evacuation. Evacuation shelters are in full operation. The Red Cross, county social services and health departments provide evacuees with shelter, food and medical care if needed. Other county departments also assist during the evacuation phase.

In the aftermath of the hurricane, the county provides protection from looting, damage-assessment estimates and continued operation of the shelters as needed.

Dick Simmons, emergency-management coordinator for Pamlico County, says his county's evacuation

plan is slightly different from others. The plan is based on the longitude and latitude of an approaching hurricane. Simmons says he would call for the evacuation of Goose Creek Island, the county's most vulnerable area, when a hurricane was at 31 degrees 15 minutes north latitude and between 70 and 85 degrees west longitude (about 15 hours prior to landfall).

"When I call for evacuation I want to be pretty confident Pamlico County is going to be clobbered or close enough to being clobbered that we're in considerable danger," he says. "The hurricane can always turn out not to be as bad as we predicted and we may over-evacuate people. But in my book an ounce of prevention is worth a pound of cure."

—Kathy Hart

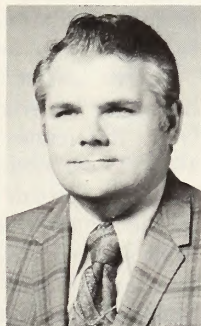


# Finding ways To survive The storm

Family preparedness plans are just one step in the process of hurricane planning. Coastal communities and the state also have a large investment in North Carolina to protect. What do they need to plan for the next big one, the one everyone says is long overdue? Is there a better way to build a storm-resistant structure, evacuate a community, predict flooding or estimate erosion? Sea Grant researchers have been looking for answers to these questions and more to help North Carolina's coastal towns prepare and plan for hurricane.

• Survivability was the key word in Jerry Machemehl's research work for Sea Grant two years ago. Machemehl, formerly an associate professor of marine science and engineering at North Carolina State University (NCSU), set out to design a coastal structure that could withstand the battering and brutal forces of a hurricane. But first, he looked at how buildings were being built and found many weak areas.

Building codes and construction standards in North Carolina changed after the devastating storms of the late 50s and early 60s. Coastal property owners got the message when Hazel left only five of 357



*Machemehl*

buildings on Long Beach intact. New homes were elevated on pilings to clear storm tides and setback from the shoreline to prevent undermining by erosion. "Building codes were strengthened and upgraded," Machemehl says, "but they were basically minor improvements. The codes were still not designed for beach construction for the forces found in a coastal environment."

During his project, Machemehl did a survey of homes along the North Carolina coast and found that only 10

*Photo by Spencer Rogers*



*The pilings on this Carolina Beach building weren't sunk deep enough to withstand the temporary erosion caused by Hurricane David*

percent of the homes were strong in several areas he determined to be vulnerable to wind and water damage. He also learned first-hand about some of these more vulnerable areas when he surveyed the damage left by Hurricane Frederic in Gulf Shores, Alabama in 1979. Machemehl made the following suggestions to strengthen coastal construction: First of all, build the house above the storm surge level and sink the piles deep enough for strength. Bolt piles securely to the floor structure and cross-brace the piling structure on the sides not facing the ocean. Last, yet most importantly, tie the whole structure together, all the way from the ground to the rafters, with metal connectors.

Machemehl's work is reflected in the state building code and has been reported in journals, but his major contribution has been in defining those weak spots in coastal construction. He hopes

that not only will property owners follow his suggestions when building, but that architects, engineers and contractors will refuse to build anything less than a "survivable" structure. "You can't build anything that can survive a two-hundred year storm," he says, "but you can build a structure that will survive many of the forces found along the coast in lesser storms."

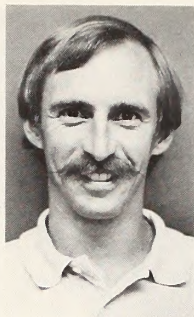
• Spencer Rogers has seen a lot of changes in coastal construction and design over the years. As Sea Grant's coastal engineering specialist, he's aware of the forces man must battle just to have that place at the beach. Erosion and storm damage are the worst.

Erosion eats away, on the average, about three and a half feet of coastline each year. "If a structure is to have a useful life on the beach," Rogers says,

*Continued on next page*



"it must be able to survive long-term erosion, a typical and natural phenomenon. A second concern is temporary erosion caused by a major hurricane or storm."



Rogers

To aid the property owner in selecting a building site and meeting the standards for federal flood insurance, the Office of Coastal Management (OCM) conducted a study to determine ocean erodible areas of environmental concern. Rogers worked with the OCM staff, mapping beach profiles and measuring long-term erosion, to determine which areas along the coast suffer the most severe changes. As a result of the study, the state chose setback standards for building which are regulated by the Coastal Area Management Act (CAMA).

As for building on the coast and surviving a storm, Rogers says that's just like flipping coins with your house—heads or tails, win or lose. He explains that in this manner: A 100-year storm has a one-percent chance of occurrence in any given year. The average useful lifetime of a residence is roughly 70 years before it wears out or is destroyed by other causes. The chances of a beach home experiencing at least a 100-year storm are roughly 50-50. Over the life of a 30-year mortgage, chances are about one in four that the beach house will be hit by a major hurricane.

With such high risks, Rogers says building to exceed the minimum construction standards is frequently a wise investment. Rogers has worked with the state in revising and updating building codes to make structures more resistant to high winds, crashing waves, storm surge, flooding and erosion.

"In building near the beach," Rogers says, "the most consistent error people make is that they drastically underestimate the degree of change that goes on. Structures cannot always survive those changes. People take learned concepts of building in Raleigh or Kansas, where the land processes are very slow events, and try to apply them to the coastal area. The surface veneer down here is always

Photo courtesy of the Division of Archives and History



*This old photo shows the damages and the boats washed up in the streets of Swansboro after flooding from Hurricane Hazel*

changing," he explains, "and they must keep that in mind when they build."

- Flooding is the major cause of destruction during a hurricane. The storm surge and torrential rains that accompany the storm raise the water level, flooding low-lying areas while waves and currents erode beaches, undermine coastal structures and wash out roads. Nine out of 10 hurricane-related deaths are due to drowning. Lives and property could be saved if there were some method of determining which areas flood and by how much. Researchers on a new Sea Grant project are working on just such a method.

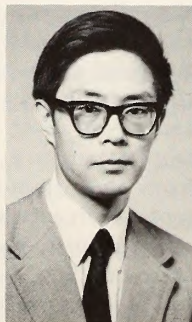
C. C. Tung, a professor of civil engineering at NCSU, and his graduate assistants are refining a state-of-the-art computer model that can simulate overflow and flooding in coastal areas. Geographical data has been plugged in for six sample profiles which will be used to test the model: Browns In-

let, Kure Beach, Wilmington, Roanoke Island, Hampstead and Cape Fear. By putting in information on the speed, intensity and direction of the storm, Tung hopes the model will be able to predict not only the storm surge and height of waves associated with a specific hurricane, but also how far inland the water will move.

In the last century, North Carolina has had its share of flood damages from hurricanes. Between 1897 and 1955, 67 hurricanes caused flooding in the state. Storm surge, the rapid swell in the water level produced by winds and falling barometric pressure, reached a height of 15 feet above normal with Hurricane Hazel in 1954. The torrential rains and sudden flooding that also came with the storm accounted for most of the 100 million dollars worth of damage.

"Determination of flooding is important in helping state and federal governments, industries and residents to determine where facilities can be built without undue damage when hurricane-related floods occur," Tung says. When complete, he says the model will be made available to state and federal government agencies.

"The development of such models should eventually serve two pur-



Tung



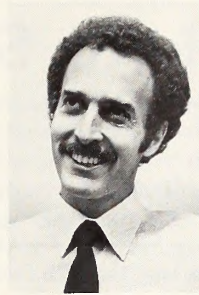
poses," he says, "for decisions about future development and for hurricane warning evacuation efforts." Given the flood patterns of a community, local officials could make better decisions about development and enforce the building codes and federal flood insurance regulations. He says the model can also help communities make decisions about evacuation routes and timing.

- If a hurricane warning is given for your community, do you know the safest route out? How long will it take to reach "high ground" or the nearest emergency shelter? These were the kinds of questions John Stone was seeking answers to in his Sea Grant project this year. He found a relatively simple way of getting them, too.

Stone, an assistant professor of civil engineering at NCSU, was familiar with the transportation studies for evacuation which had been done for other states, such as Texas and Florida. But, the computerized models were for metropolitan areas, and the North Carolina coast is dotted with

small communities. So, Stone employed some traditional traffic-engineering methods, calculated for the worst storm possible, and considered the following factors for two sample areas: the population and its density; coastal topography; the transportation system and the number of alternate routes; and the storm with its location, intensity, speed and direction of travel. The sample areas chosen were Holden Beach and Goose Creek Island.

Both areas fared well when the simple techniques were used to judge evacuation, despite the fact that Holden Beach's estimated summer population of 10,000 has only one road out and a bridge to cross. Goose Creek residents have a bridge to cross, several low-lying roads subject to flooding and some congestion when ad-



Stone

jacent communities funnel into the road out. In addition, heavy rains, low visibility, high winds, road washout and flying debris can make the usual 30-minute drive a three-hour ordeal. But congestion is the worst.

"In the coastal area, it's been said that the roadway systems have been in place for twenty-five years," Stone says. "The capacity of those roadways has remained the same, but the development of the coast has expanded astronomically and will overload the roads."

The simple techniques Stone used in his Sea Grant project can be used by any coastal community to determine an adequate evacuation time and identify critical points. In gathering the necessary population and transportation data for the evacuation study, local community officials can also become more familiar with their roadway system and what sort of planning can be done to alleviate the current problems.

—Cassie Griffin

## A plan for The aftermath

What does a town do when a hurricane all but wipes it off the face of the earth? Reach for its post-disaster plan, according to the Coastal Resources Commission, and follow the guidelines for reconstruction.

The post-disaster plan idea, the brainchild of the commission, made its debut this past summer when it was introduced in Manteo and Wilmington. The reason? "After the devastation of a hurricane, it's utter chaos," says Parker Chesson, chairman of the commission. "And that's not the kind of atmosphere for making decisions about where structures are going to be rebuilt and roads relocated." Proposed guidelines were open for discussion, and the idea was well received by many of the coastal officials attending the meetings.

Chesson said that while most coastal communities have emergency evacuation plans, none had a plan for post-disaster reconstruction. In developing the idea and proposed guidelines, members of the commission studied other states, particularly Gulf Shores,

Alabama, which was devastated by Hurricane Frederic in 1979. The mayor of Gulf Shores told the commissioners that the lack of a post-disaster plan was at the root of their town's rebuilding problems. "Inadequate zoning and building codes," Chesson says, "allowed all buildings to be put back in exactly the same locations where the storm had demolished them. We don't want that here."

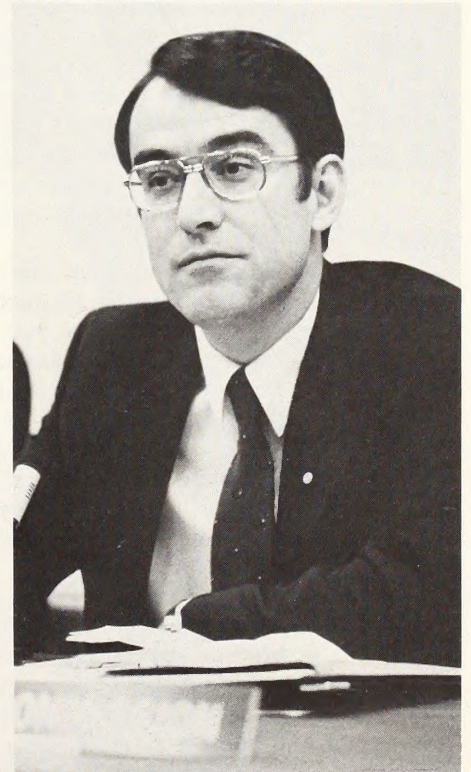
With the general policy and guidelines proposed by the commission, coastal communities are asked to establish plans which include an inventory of buildings, a list of property owners and policies for desired relocation of roads, utilities and public and private development. "These guidelines aren't going to do much for post-disaster without the local communities getting involved themselves," Chesson says, "and most local governments do want to have control over how their community is going to grow and develop."

North Carolina is "out in front," Chesson explains, with the post-disaster plan, and with good reason because of federal cutbacks in relief funds. He says that it is going to be much easier for towns to get help in reconstruction if they show wise use of

the funds and a cooperative plan of action with state and local government agencies.

—Cassie Griffin

Photo by Jim Page, NRCD



Parker Chesson



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# Hurricane Safety Checklist

According to John Sanders, you can never be *too* prepared for a hurricane. As Sea Grant's coastal weather awareness specialist, he has spent the last year and a half working with the media, communities and government officials to increase their understanding of hurricanes and the damages and

hazards associated with severe storms. To help individuals prepare for a hurricane and protect their property, Sanders developed a hurricane safety checklist tailored to the North Carolina coast.

STEP 1. Is your home on land which is less than 20 feet above sea level?

If yes, go to Step 3.

If no, go to Step 2.

STEP 2. Do you live within two miles of the ocean or one mile of a sound or river?

If yes, go to Step 3.

If no, go to Step 4.

STEP 3. You live in an area which is vulnerable to flooding during a hurricane. Because nine out of 10 hurricane-related deaths are due to drowning, you should use the following checklist to prepare for a hurricane emergency. You should make decisions now about where you will go if you have to evacuate, how you would get there and how long it would take you to move to safe shelter.

A. If a *hurricane watch* is issued for your area, take the following precautions:

1. Drive to a nearby gas station and fill your tank.

2. Store or tie down all outdoor objects, such as garbage cans, outdoor furniture and garden tools.

3. If you own a boat, moor it adequately. Remember that tides can increase from 10 to 20 feet above normal. Take this into consideration when securing lines. If your boat is small enough, move it onshore. Fill the boat with water or tie it down to keep it from being blown about by the hurricane winds.

4. Tape or board up the windows of your house.

5. Pack valuable papers such as deeds, wills, insurance documents and contracts, to take with you.

6. Prepare a survival box containing a medical first-aid kit, special medication which you or other members of your family may need, rope, flashlight, transistor radio, extra batteries, containers of fresh water, water purification tablets, non-perishable foods, one change of clothing and sleeping bags.

7. Contact friends, relatives and/or neighbors to let them know of your plans. Monitor radio and television reports for updates on storm conditions.

B. If a *hurricane warning* is issued, prepare to evacuate. Take the following steps immediately:

8. Shut off the main power switch and main gas valve. Elevate your appliances, such as refrigerator, stoves, washer, dryer and freezer, above the floor to minimize water damage. Cover the refrigerator and freezer with newspapers and blankets for insulation

and to prevent food spoilage.

9. Go through the checklist once more and make sure that you have completed all of the steps.

10. Evacuate. If you are handicapped and/or need transportation, call your local office of Emergency Management.

STEP 4. You may be able to ride out the storm in your own home. However, if you live in a mobile home, you should go back to Step 3 and plan to evacuate. (Even mobile homes which are anchored and have overhead braces are vulnerable to wind damage.)

A. If a *hurricane watch* is issued for your area, take the following precautions:

1. Drive to a nearby gas station and fill your tank.

2. Store or tie down all outdoor objects, such as garbage cans, outdoor furniture and garden tools.

3. If you own a boat, moor it adequately. Remember that tides can increase from 10 to 20 feet above normal. Take this into consideration when securing lines. If your boat is small enough, move it onshore. Remember to fill the boat with water or tie it down to keep it from being blown by the hurricane winds.

4. Tape or board up the windows of your house.

5. Check the batteries for your flashlight and transistor radio. Make sure you have extra batteries.

6. If you require special medication or prescription drugs, make sure that you have an ample supply before the stores close.

7. Store plenty of fresh water in containers. Make sure that you have several days' provisions of non-perishable foods.

8. Contact friends, relatives and/or neighbors to let them know of your plans. Monitor radio and television reports for updates on storm conditions.

B. If a *hurricane warning* is issued, take the following steps immediately:

9. Shut off the main power switch and main gas valve. Cover your refrigerator and freezer with newspaper and blankets for insulation and to prevent food spoilage.

10. Go through the checklist once more and make sure that you have completed all of the steps. Then, go indoors and stay indoors. Brace all doors to prevent wind damage. Monitor storm reports with your transistor radio. Stay indoors until an official all-clear notice is given.

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# One family's plan for hurricane preparedness

This past spring, seventh- and eighth-grade students at Pamlico Junior High School in Bayboro took Sanders' checklist and developed their own family checklists. As part of a year-long focus at the school on hurricane preparedness, this project had students working with Sanders, their parents, teachers and local emergency management officials. An example of one student's work is listed below.

Plan for a home on land less than 20 feet above sea level.

A. Do the following in case of a hurricane watch:

1. Drive 1.6 miles to Grantsboro. Fill car and truck gas tanks. This takes approximately 12 minutes.
2. Put two bicycles, one push mower, 13 tomato planters, two ladders, one radio antenna, one wheelbarrow and two sawhorses in garage. Put spare lumber under two-story storage shed.
3. Move boat and trailer next to two-story shed. Secure boat to trailer and trailer to building supports. Fill boat with water; then put hose in garage.
4. Get 4' x 5' sheet and 5' x 9' strip of plywood from second floor of shed. Get nails and hammer from garage and board up picture window. Get masking tape from garage and tape 13 small windows in the house, eight in the shed, and five windows in the garage.
5. Get deeds, insurance and birth certificates from top drawer of the file cabinet in the master

bedroom. Get car title from bill holder on dining table. Pack all of these in the smallest blue suitcase in the attic.

6. Pack a survival box. Include flashlight, radio, spare batteries, blankets, rope, fire extinguisher, a change of clothes, desired non-perishable food, fresh water and water purification tablets. (If you have none, they are available at local drug stores.)
  7. Contact neighbors, friends and relatives and tell them of your plans.
  8. Lower radio tower in back yard.
- B. If a hurricane warning is issued, take the following steps immediately:
1. Raise all appliances up on concrete blocks. Insulate refrigerator and freezer with blankets.
  2. Shut off main power switch in utility room. Breaker box is next to washing machine.
  3. Go through checklist. Make sure all steps are completed.
  4. Pack survival box and suitcase of important documents in car. Drive 5.4 miles to nearest shelter—Fred A. Anderson School in Bayboro. This takes 8 minutes.

Hubert W. Buck  
Eighth Grade  
Pamlico Junior High School  
Bayboro, North Carolina

Photo by Tommy Baab, The News and Observer

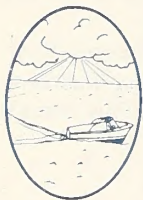


Pamlico Junior High School students check the contents of a hurricane evacuation survival box



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



There's a new threat to some of North Carolina's water supplies, but it's not drought or a toxic chemical. The culprit is an aquatic weed,

*Hydrilla verticillata*.

Ron Hodson, Sea Grant's associate director and an NCSU zoologist, is leading a research project aimed at finding ways to control the weed, which has appeared in 15 lakes and reservoirs around Raleigh. Officials are worried that the weed will spread as it has in Florida, where it clogs waterways with a thick mat of vegetation, choking out recreational boating and fishing. The threat to Raleigh-area water supplies is serious, Hodson says, since hydrilla infestations can lock up as much as 60 percent of the water in a lake.

Hodson and his team, which includes Neil Rhodes, David DeMont and Melvin Huish of NCSU, and Graham Davis of East Carolina University, are setting up test enclosures in several Wake County lakes. In the enclosures, the team will test an integrated approach to weed control that includes the use of herbivorous fish, periodic draw-downs to lower water levels, and applications of approved herbicides. When their studies are complete, the team plans to recommend hydrilla-control measures to the City of Raleigh and the Water Resources Research Institute, both of which funded work on the project.

Hydrilla, which is not native to the U.S., probably came here from South America as a plant for aquaria. It was

found growing in Florida in 1960. No male hydrilla plants have been found in the U. S., and the weed produces no seed here. Even so, it proliferates through several forms of vegetative reproduction. Once established, the hydrilla takes root in the lake or river bottom, forms a tuber there, grows to the surface, and shades out its competition.

So far, the only hydrilla reported in North Carolina has been in Wake County, where heavy infestations have troubled three lakes in the William B. Umstead Park. Hydrilla has also found its way into Lake Wheeler, a municipal reservoir for Raleigh.

Hodson says the public can help control the spread of hydrilla by taking care not to transport it out of an infested area. A single sprig carried off on a boat or trailer can live to start a new colony, he says. He also cautions people not to discard any exotic plant or fish in such a way that it can survive to reproduce.



Sea Grant researcher, Tyre Lanier, has added an international perspective to his project this year. Takayuki Akahane, a biochemist from Tokyo, Japan, is spending a year in the United States working with NCSU's Department of Food Science on Lanier's surimi research.

Surimi, which is washed and minced fish, is popular in Japan, where it is the base of a variety of seafood products. In his Sea Grant work, Lanier has combined ground shrimp with surimi to produce a shrimp-shaped seafood that not only fooled a panel of tasters, but also sparked the interest of several major food companies. But, there were still unanswered questions about surimi, so Lanier welcomed a link to Japan's surimi know-how.

Taka is running several tests on Lanier's surimi to find a new additive source and to measure changes in fish-meat quality. At present, sugar is being added to surimi products to im-

prove gel properties. While the Japanese like a hint of sweetness in their surimi, Americans balk at the taste and added calories. Taka is testing a solution that he hopes will halt the process of muscle changes during storage and in that way preserve the fresh quality of the fish meat.



Wayne Wescott, UNC Sea Grant's new marine advisory agent, has joined Hughes Tillet in the Sea Grant office at the N. C. Marine Resources Center on

Roanoke Island.

Wescott, a native of Manteo, brings a solid base of experience to the Sea Grant program. He received his undergraduate and masters degrees in business administration from East Carolina University. He has worked as a commercial fisherman and managed a fishing cooperative in Dare County. Wescott has also been an extension education and training specialist for commercial fishermen under a Sea Grant education project. With the project, he planned, developed and scheduled courses and workshops to help fishermen learn about new types of gear, new fishing methods, marine finances and more.

If you'd like Wescott's help, give him a call. The number is (919) 473-3937.



In May 1979, much of the Brittany coast of France was ruined by an oil spill from the huge *Amoco Cadiz*. Miles of marshlands were destroyed, valuable fish and wildlife habitats were spoiled, and the shoreline lay open to erosion. Ernie Seneca, a botany professor at North Carolina State University, was called in to help re-establish the marsh, using several grass-transplanting techniques he developed during a Sea Grant project. Two years later, the same site is



on the way to a recovery.

This past summer, Seneca was awarded the Gulf Oil Corporation Conservation Award for 1982 for his work in France, similar work along the North Carolina coast and his work with students on campus. This prestigious award is given each year to 10 professionals and 10 non-professionals who do work in the field of conservation. Each recipient is given a cash award, a bronze plaque and a pin. Seneca couldn't attend the awards ceremony this summer in Washington, D.C. because of a return trip to France to restore another coastal area.

Seneca's Sea Grant work, which he conducted with Steve Broome and W. W. Woodhouse, Jr. of NCSU's Department of Soil Science, has led to two Sea Grant publications, *Planting Marsh Grasses for Erosion Control* and *Building and Stabilizing Coastal Dunes with Vegetation*.

Lundie Spence, UNC Sea Grant's marine education specialist, was named president-elect of the National Marine Education Association at its annual meeting in San Diego in August. She was elected to the position by 1400 fellow marine educators. She will succeed Prentice Stout, the marine education specialist for the University of Rhode Island Sea Grant Program, as president in 1983.



Want to learn how to cast a line, build a trap or photograph a wild animal? Plan to attend National Hunting and Fishing Day activities, to be held September 25,

from noon to 6 p.m., at the N.C. Marine Resources Center on Roanoke Island. The event is being sponsored by the Pea Island National Wildlife Refuge and the center. Admission is free.

Lundie Spence, UNC Sea Grant's marine education specialist, will be on hand to present a program on sharks and to cook a shark casserole for the group to sample. A representative from the Smithsonian Institute will talk about marine-mammal strandings. And, there will be demonstrations on fishing, trapping, hunting, training dogs, photographing wildlife and more.

If you're interested in contributing a

display about outdoor recreation or in demonstrating a special technique—say, fly-tying, duck-calling or bait-rigging—call Bonnie Woodall at the Pea Island National Wildlife Refuge, (919) 987-2394.

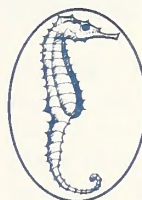
Jim Murray, UNC Sea Grant's Marine Advisory Services (MAS) director, was elected chairman of the MAS leaders at a meeting of the Sea Grant Association in Washington, D.C. in July. He will be responsible for arranging next year's MAS agenda for the association meeting in San Antonio and serving as a spokesman to the Council of Sea Grant Directors.



Hurricanes got lots of attention from the media during Hurricane Awareness Week, August 2-5, and Sea Grant people figured in several of the stories and newscasts. John Sanders, Sea Grant's weather awareness specialist, appeared on a number of TV news shows, explaining the forces of hurricanes and how people can prepare for them. Spencer Rogers, Sea Grant's coastal engineer, and John Stone, a NCSU

civil engineer who recently completed a Sea Grant study on hurricane evacuation, also served as sources for several news stories and telecasts during the week.

Cassie Griffin, of Sea Grant's communication's staff, appeared on a Havelock cable-television program, interviewing students from Pamlico Junior High. The students talked about the things they had done to prepare their families for a hurricane.



*Sea Grant Today*, published by the National Sea Grant College Program, is free for the asking. This bimonthly publication, which is aimed especially at industry, includes articles written by communicators, researchers, marine advisory agents and educators throughout the Sea Grant network. A list of new Sea Grant publications is also included in each issue.

For your free subscription, write *Sea Grant Today*, Food Science and Technology Building, Virginia Tech, Blacksburg, VA 24061.

*Continued on next page*

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, Box 5001, Raleigh, N.C. 27650.

Name \_\_\_\_\_

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City•State•Zip Code \_\_\_\_\_

To help us specialize our services, please answer these questions.

I am in the following line of work:

- |   |  |
|---|--|
| <input type="checkbox"/> Boatbuilding/Repair    | <input type="checkbox"/> Marina operator                 |
| <input type="checkbox"/> City/County government | <input type="checkbox"/> Marine recreation               |
| <input type="checkbox"/> Commercial fishing     | <input type="checkbox"/> Mass media                      |
| <input type="checkbox"/> Educator               | <input type="checkbox"/> Seafood processing/marketing    |
| <input type="checkbox"/> Farming                | <input type="checkbox"/> State government                |
| <input type="checkbox"/> Homemaker              | <input type="checkbox"/> University professor/researcher |
| <input type="checkbox"/> Lawyer                 | <input type="checkbox"/> Other _____                     |

Coastal property owner ☐ yes ☐ no    Boat owner ☐ yes ☐ no





Would a mountain trout raised in coastal waters taste as sweet? According to Sea Grant staff at the Aquaculture Demonstration Project in Aurora, the answer is yes. In an experiment begun last December, Johnny Foster and Randy Rouse, both of the project, stocked two ½-inch mesh cages with 870 mountain trout weighing about 2.5 ounces and measuring six inches long each. Foster and Rouse hung the cages from their pier in South Creek, which runs by the Aurora lab.

Melvin Huish, an NCSU zoologist who has been conducting Sea Grant research at the Aurora site, helped the project secure the young trout, which were provided by the U.S. Fish and Wildlife Service.

During a fish kill in the Pamlico River in late December, 429 of the trout died. Though the exact cause of the kill has not been determined, fisheries experts believe either a virus or an algae bloom triggered the kill, Foster says.

The remaining fish were fed a commercial trout feed and 420 trout were harvested in late May. The average weight then was 9.3 ounces and the length 10 inches, the normal harvesting size for mountain trout. And the flavor, Foster says, was excellent.

More work is planned to see if trout could be raised commercially in coastal North Carolina.



It takes careful planning to help any expanding industry avoid growing pains. That's why Sam Thomas and Dave Hill are working on some flexible building designs for seafood processing houses.

Thomas and Hill, both with Sea Grant advisory services at the NCSU Seafood Laboratory, are designing a multi-use building for the Wanchese Harbor Seafood Industrial Park. They have been working with Bruce Strickland of the Department of Commerce and Robert Williams of the North Carolina Seafood Industrial Park Authority on the building plans. Thomas says the basic building can start as a small fish house and grow with the owner's business into a large seafood processing plant. Plans also allow for flexibility in the transition from one owner to another, or from one type of processing business to another.

And, while Thomas and Hill spent some time at the drawing board, their colleague at the lab, Joyce Taylor, took her work on the road. Some dozen workshops later, groups from across the Carolinas had gotten some help with seafood preparation and nutrition, plus a taste of such fare as fish-flake salad and baked clams. Frank Thomas, project director at the lab, chimed in with advice on buying and cleaning fresh seafood.



*Albemarle Sound Trends and Management* is the latest in Sea Grant's series of technical reports. The report is the proceedings of a conference held March 3 at the College of Albemarle in Elizabeth City.

The conference, which attracted about 150 participants, invited scientists and leaders to review the sound's water-quality problems and to assess current management alternatives. It was sponsored by the UNC Water Resources Research Institute and Sea Grant. For a copy of the proceedings, write UNC Sea Grant. Ask for publication UNC-SG-82-02.

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## COASTWATCH

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# COAST WATCH

Photo by Kathy Hart



NOV 9 1982

## When people Are the point

*At Sea Grant, we can tell you most of what we're up to in just one word: People. It is our belief that all the painstaking research in the world goes for naught unless people benefit. Sea Grant takes some of the best science our universities can offer and puts it to work out there on the dock, in the marketplace, in society.*

*This month, we thought we'd introduce two of the people who help make sure marine science is more than just words on a chalkboard or chapters in a textbook. As Jim Murray, director of Sea Grant's Marine Advisory Services, puts it: "These agents and specialists work with the public, and that means they can keep the university in touch with what the research needs are out there along the coast. It's a two-way flow."*

*We've singled out two of Murray's team—Lundie Spence and Bob Hines—only to give you a closer look at what the workdays of a specialist and an agent are like. We hope you get a chance to meet the rest of the team, too—they're all top-notch. If you want their help, give them a call. They'd like to hear from you.*

Lundie Spence, bringing the coast into the classroom



# If teachers can't fly, don't tell Lundie

Back during the heat of July someone asked UNC Sea Grant Director B. J. Copeland what Lundie Spence was doing these days. His reply? "The last time I saw Lundie, she was wading through the marsh wearing her bathing suit and big straw hat and flapping her arms like a bird. Behind her were fifteen teachers doing exactly the same thing."

Those who meet Lundie Spence rarely forget her boisterous enthusiasm or her echoing cackle. They go with a go-get-em attitude that makes her job as UNC Sea Grant's marine education specialist, well, special.

Lundie travels from the mountains to the coast of North Carolina, peddling marine education, and her enthusiasm for the marine environment spreads like a brush fire. She'll have you feeling an eel, tasting shark or wading knee-deep in a salt marsh before you have a chance to decline.

Lundie's not keen on negatives. On the job she neither takes nor gives no for an answer. There is always a way. And that way has meant more marine education for teachers and students alike.

Lundie helps teachers and science coordinators introduce and organize marine-education curriculums and materials. She also works with vocational teachers, especially along the coastal counties, to introduce marine fields—boatbuilding, aquaculture and fishing—to the vocational student.

But it takes more than hard work to make marine education catch fire. It takes a spark. And many educators believe Lundie has been that spark in North Carolina.

She has planted the idea of marine education among science and vocational coordinators in school systems like Charlotte-Mecklenburg,

Guilford and Pamlico. She fed the idea by conducting workshops among teachers, and by supplying enthusiasm, ideas and materials. At last the idea blossomed as teachers carried marine education back to the classroom, where they captured the interest of students through coastal field trips and classroom exercises.

Mary Kearns, science supervisor for Guilford County's schools, says Lundie has worked with both teachers and students in her school system to increase their knowledge of the coast. "She has shown us some neat things that really bring the coast to the classroom," Kearns says. "We've learned how to teach our students to graph the ocean floor without ever leaving the school."

"I feel like it is very important to learn about the marine environment. Most of our children go to the coast for vacation. They need to know there are

*Photo by Kathy Hart*



*Lundie and third graders encounter the secrets of marine science at Underwood Elementary School*



things to see and do there besides swimming in the ocean and watching the bikinis go by."

For Lundie every creature, tidal marsh, dune and yaupon bush is a lesson in coastal ecology. And she doesn't mind standing shin-high in muck to show a teacher a marsh periwinkle inching up a blade of cordgrass or an egret stalking its prey.

"She believes that getting in there and doing it or seeing it is the best experience a teacher can have," says Jo Duckett, assistant program director and education coordinator for the science museums of Charlotte, and the former science-resource teacher for the Charlotte-Mecklenburg Schools. "With Lundie you experience marine education. She lives marine education and she makes you aware of marine education as a holistic kind of thing."

Besides working with regular classroom teachers, Lundie has also made a special effort to help vocational and home economics teachers introduce more marine topics to their students. Carter Newsome, regional coordinator for vocational education in southeastern North Carolina, says Lundie assisted in development of a marine occupations curriculum, arranged tours for vocational students at marine laboratories and conducted a workshop for marine occupations teachers at Sea Grant's Aquaculture Demonstration Project in Aurora.

"She's really inspired our vocational teachers to stretch out, to learn and to grow," Newsome says. "Lundie has promoted the scientific aspect of vocational teaching. She's inspired enthusiasm among our teachers and a quest for up-to-date marine information."

When Lundie is not on the road giving workshops, she's often in her Raleigh office on the phone to teachers, science coordinators or museum personnel wanting to know such things as where they can find a film strip on estuaries or a book on marine mammals.

"She's a connector," says Jo Duckett. "Because of her knowledge of her subject matter she can quickly look at the needs of an individual or group and match the resources, people or materials, they need. That is a very important skill."

Jim Smith and Steve Benton of the state Office of Coastal Management recently put together a peat-mining



*With "adaptation games" students learn about marine life*

workshop for teachers in Washington County. They contacted Lundie for a little help. "She told us how to present our materials so we could be sure we were communicating to the teachers the information we wanted them to know," Benton says.

Lundie doesn't let state boundaries stop her when it comes to connecting people and resources. As president-elect of the National Marine Education Association, she draws on the ideas and resources of educators from coast to coast. And, she works with Sea Grant marine education specialists from Hawaii to Maine to target marine education needs nationwide.

As a teacher for six years, Lundie knows teachers don't always have the resources they need readily available. That's why she helped to put together four marine education manuals, covering coastal ecology, geology, history and seawater. The manuals offer information about the coast and exercises that bring the coast into the classroom. Lundie's latest manual, written with Jaynee Medicott of the 4-H Marine Awareness Project, is a guide to marine resources, aquaria and touch tanks, and coastal field trips. She also produces a marine education newsletter for educators. It is distributed free

four times a year.

Lundie's job as an education specialist wouldn't be complete without some time in the classroom. Lundie teaches an interdisciplinary "oceans" course at North Carolina State University. Drawing on the expertise of Sea Grant researchers, specialists and agents as well as other coastal specialists, Lundie teaches about twenty-five college students everything they can learn about the coast in fourteen weeks. The highlight of the course is a weekend field trip to the Cape Lookout National Seashore, where they learn about barrier-island ecology and shoreline processes from Stan Riggs, an East Carolina University geologist and Sea Grant researcher.

While Lundie's dedication to marine education seems endless, she is always quick to point out that she is not alone in spreading the marine education gospel. "I get a lot of support from the Marine Resources Centers and from the coastal and inland museums and nature centers," Lundie says. "Without them I couldn't be nearly as effective as I am."

—Kathy Hart



# Pushing facts, Not paper

Photo by Neil Caudle

"Anytime I have to call on Bob he's available to give me the latest information on a new piece of gear or check into some new ideas I'm interested in. He's a really great listener, and I've got a lot of confidence in what he tells me."

Jim Etheridge, owner of Lowland Marine Supply in Bayboro, says he sees or calls Bob Hines at least once a month with questions and ideas. Hines is a Sea Grant marine advisory agent. His office is in the N.C. Marine Resource Center at Bogue Banks. But during the course of the day, he's just as likely to be found in Bayboro or Harkers Island or, even better, somewhere out in the Atlantic. He talks to commercial fishermen. He teaches surf-fishing. He leads a field trip. He's the information man, if you're interested in fishing in the central coastal area of the state—in Beaufort, Carteret, Craven, Onslow and Pamlico counties.

Here's some of what Hines has been up to lately: — Marine fouling on crab pots is a big problem for crabbers. A new anti-fouling paint, which was tested in Maryland in a Sea Grant project, not only significantly reduced fouling, but also extended crab pot life. Catch figures gathered over time also indicated that the pots treated with the new paint caught more crabs. Would the anti-fouling paint work in North Carolina? Hines received a Sea Grant mini-grant to find out and has set out 30 pots, treated and untreated, to do his own study. He also set up two demonstrations to introduce the new paint to crabbers, and gave them a chance to have some of their pots painted in exchange for data.

— In 1981, Sea Grant marine agent Jim Bahen organized a first for commercial fishermen in North Carolina—a work boat show. The show was held in Wilmington and featured the new boats and fishery products on the market. This past spring, a second work boat show, held in Morehead City, was co-organized by Hines and Larry Giardina, another Sea Grant marine advisory agent. Attended by over 4,000 people, the show featured 45 commercial exhibits and a series of short seminars with topics ranging



*Hines checks crab pots in a marine-fouling study*

from tax management to diesel maintenance. At the show, Hines conducted a seminar on maintaining boats and gear.

— To provide timely information on Sea Grant activities and other marine topics of local interest, Hines and Giardina started *Marine Advisory News* last year. Published 12 times a year, the free newsletter now has over 1,000 fishermen, seafood dealers, marina operators and coastal property owners for subscribers.

— To encourage more young people to consider the seafood industry as a career choice, Hines works with Lundie Spence, Sea Grant's marine education specialist, in vocational in-service

training programs. Each summer, Spence runs summer workshops designed to teach educators more about commercial fishing and seafood processing and preparation. In his section on commercial fishing, Hines discusses the different types of gear used to catch the various types of seafood harvested in the state.

Probably the most frequent and most numerous requests Hines gets are for information on recreational fishing—what can I catch when, where and how. "People call or come in the office all the time," Hines says, "and they want to know where they can go crabbing, when's the best time and how many can they catch. Or, they





*Hines has encouraged boat-owners to maintain their equipment*

want to know how to surf fish and where they can drive on the beach to fish." Hines has several ways of providing this information:

— With an office at the N. C. Marine Resources Center at Bogue Banks, Hines is constantly in contact with people interested in marine resources, and those numbers increase during the summer months.

Not all of Hines' requests come from the coast or even from the state. An ad agency in New York City wanted to know how many fish there are in the ocean. A fellow from North Dakota wanted to sell his restaurant, move to North Carolina and become a commercial fisherman. Hines says the man is reconsidering the idea. "I think he was laboring under the impression that it was an easy, glorious way to make a living," Hines says.

And, then there's work with other Sea Grant programs and state and federal agencies. Agents transfer information about new gear or fishing techniques from state to state and from coast to coast. "I'm working with an agent in Alaska now who has requested information on the anti-fouling paint I'm using in my crab-pot

study," he says. "He is hoping they can use it up there on octopus pots to stop their marine-borers problem."

What kind of person is a marine advisory agent? "I'm kind of a jack-of-all-trades, I guess, since you have to be responsive to all types of marine interests," Hines says. "You can call yourself an expert, or knowledgeable anyway, in one particular area, but whoever walks through that door or calls on the phone, well you've got to be able to answer the question or know where you can find the answer. Sometimes that just takes one phone call, and sometimes it may take a couple of days of calls and searching."

Hines isn't desk-bound, or even at his desk at all somedays. He doesn't mind the lack of a daily routine which comes with his job. "With the diversity of things I get involved in, I haven't had a day yet when I have gotten bored because of doing the same things over and over too many times," he says. "There's enough different things to do during any given day where you don't get tired of doing it. Besides, I like folks, I simply enjoy working with people. I guess that's what I enjoy the most."

## Weather news, Relay-style

Sea Grant agents and specialists connect people—people who have problems or questions with people who have answers. They may help an eel exporter find a supply of American eels, a marina operator learn more about insurance or a coastal homeowner fight erosion.

Jim Bahen, Sea Grant's marine advisory agent in Wilmington, is trying to help commercial and sportfishermen learn more about fickle offshore weather. He knows when a fisherman leaves the dock the weather may be sunny and the seas normal, but 35 miles offshore, squalls packing shifty winds and six-foot waves may send the fisherman back to the dock with no fish.

Fishermen need better weather information about the intermediate offshore zone (18 to 50 miles offshore) to make sound fishing decisions. Bad weather can endanger lives and waste time and fuel if conditions are too poor for fishing.

The National Weather Service (NWS) offers a marine weather forecast covering 0 to 100 miles offshore. But Al Hinn, meteorologist-in-charge at the NWS in Wilmington, says the weather information isn't as complete as he would like.

The Gulf Stream, which meanders northward off the North Carolina coast, creates some special offshore forecasting problems. "There can easily be a ten- to fifteen-degree temperature difference in the air over the Gulf Stream," Hinn says. "The temperature difference causes more evaporation, more clouds and more showers and thunderstorms. These can be localized conditions that aren't general to the whole offshore zone."

To make its offshore forecast the NWS relies on information from one weather buoy off Frying Pan Shoals and information relayed from cooperative ship reports, a fish house in Southport and a marina in Atlantic Beach. "That amounts to thirty to fifty reports a month," Hinn says. "That's only one to two reports a day and some days we get no reports."

To help the NWS offer better forecasting for fishermen, Bahen is

*Continued on next page*



drawing together a network of people from industry, government and the fishing community to organize a weather relay program.

Plans call for a 90-foot tower, donated by NCS International, a geodetic and marine positioning and surveying company, to be set up at the N.C. Marine Resources Center at Ft. Fisher. From the marine advisory services office in the center, Bahen (or



*Jim Bahen*

Sea Grant staffers Debbi Ford and Spencer Rogers) will communicate via VHF radio (channel 68) with fishermen in a 55-mile radius offshore of the center.

Sea Grant staffers will pass the information along to the NWS office in Wilmington. The reports will be incorporated into the marine weather forecast and broadcast over the 24-hour National Oceanic and Atmospheric Administration (NOAA) weather radio. Bahen says the weather relay program should begin operation in December.

The NWS also plans to relay the offshore weather information to NWS offices in Raleigh; Columbia, S. C.; and Washington, D. C., and the National Hurricane Center in Miami, Fla. Hinn says the information will not only provide better daily weather reports, but also help meteorologists improve their forecasting ability.

"I think it's a very, very workable plan," Hinn says. "After all, aviators have been doing it for twenty years. Pilots report back their weather experiences, icing, updrafts and turbulence, so the next pilot in the area will know what to expect. It's pilots helping other pilots. And the correlation is certainly there for the marine community to do the same thing. It will be based on fishermen helping fishermen."

## Sea Grant's marine advisory team

If you have a marine question or problem, then call or write a member of the UNC Sea Grant advisory services team. Here are their names, locations, phone numbers and specialties.

Jim Murray	Director	North Carolina State University (919) 737-2454
Leon Abbas (specialist)	marine recreation, economics	North Carolina State University (919) 737-2454
Jim Bahen	commercial fishing	Marine Resources Center/Ft. Fisher Kur Beach, N.C. (919) 458-5498
Jim Easley (specialist)	economics	North Carolina State University (919) 737-2885
John Foster	aquaculture	NCSU Aquaculture Demonstration Project Aurora, N.C. (919) 322-4054
Larry Giardina	business management, marketing	Marine Resources Center/Bogue Banks Atlantic Beach, N.C. (919) 726-0125
David Hill	seafood	NCSU Seafood Laboratory Morehead City, N.C. (919) 726-7341
Bob Hines	commercial fishing	Marine Resources Center/Bogue Banks Atlantic Beach, N.C. (919) 726-0125
Spencer Rogers (specialist)	coastal engineering	Marine Resources Center/Ft. Fisher Kure Beach, N.C. (919) 458-5780
John Sanders (specialist)	coastal weather	North Carolina State University (919) 737-2454
Lundie Spence (specialist)	marine education	North Carolina State University (919) 737-2454
Joyce Taylor	seafood	NCSU Seafood Laboratory Morehead City, N.C. (919) 726-7341
Hughes Tillett	commercial fishing	Marine Resources Center/ Roanoke Island Manteo, N.C. (919) 473-3937
Frank Thomas (specialist)	seafood	North Carolina State University (919) 737-2956
Sam Thomas (specialist)	seafood	NCSU Seafood Laboratory Morehead City, N.C. (919) 726-7341
Wayne Wescott	commercial fishing, gear	Marine Resources Center/ Roanoke Island Manteo, N.C. (919) 473-3937



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



The headline reads: North Carolina hard clams murdered in Back Sound bed. Suspects include members of two underwater gangs—the blue crabs and the whelks. But detective Charles Peterson, a University of North Carolina (UNC) Sea Grant researcher and biologist at the UNC Institute of Marine Sciences in Morehead City, turned up the real culprits—snapping shrimp. The snapping shrimp (*Alpheus*), still on the scene, gave themselves away by snapping their small lobster-like claws.

The shrimp produce a noise much like a person snapping his fingers as they clamp together their powerful claws—claws capable of crushing a small hard clam. Until Peterson's discovery, most scientists thought snapping shrimp used their claws primarily to attract mates. Scientific literature contains no reports of snapping shrimp preying on hard clams, Peterson said.

Peterson did his detective work as part of a UNC Sea Grant research project. Peterson is studying the hard clam, a bivalve mollusk common to North Carolina and large portions of the East Coast, and the effects of harvest methods on the clams and their environment.

Peterson made his discovery when Brian Beal, a graduate student working on the project, checked a seed-clam experiment in Back Sound, where he was monitoring clam growth and survival. To keep out the predators, Beal had enclosed the clams in a wire cage. Instead of finding healthy clams, Beal was greeted by piles of crushed

mollusks and a chorus of snapping shrimp.

Suspecting the one-and-a-half inch shrimp may be responsible for the clams' demise, Peterson and Beal set up a laboratory experiment. Their suspicions proved correct as the snapping shrimp cracked as many as three clams a day. Peterson says the shrimp can crush clams up to two centimeters long (about one year old).

The snapping shrimp are abundant in Back, Bogue and Core Sounds, where populations run as high as 10 snapping shrimp per square meter, Peterson says. And, the shrimp aren't particularly choosy about their habitat. They're just as likely to be found tucked away in a sea grass bed as hiding among the oyster rocks.

According to Beal, in light of the findings, previous studies may have overestimated the predation rates of blue crabs. The crushed clam shell left behind by the snapping shrimp looks identical to the crushed shell left by the blue crab. Peterson says he doesn't know what percentage of the hard clam resource is being taken by snapping shrimp, but he believes it may be substantial.

With the preliminary investigation behind them, Peterson and Beal are writing their report on the case of the crushed clams, charging the snapping shrimp with the clams' demise. And what will the snapping shrimp plead. Guilty by reason of hunger.



Are you interested in learning how to raise crayfish, start a bait business or produce fish in your farm pond for profit? The answers are in a series of newspaper columns written by one of UNC Sea Grant's aquaculture experts, Johnny Foster.

Foster, a marine advisory agent at the NCSU Aquaculture Demonstration Project, began the columns last spring in response to numerous requests for information. Several newspapers in eastern North Carolina

currently are running the biweekly columns which report on the latest research in aquaculture. Topics include catfish farming, soft-shell crabs, eels, bait fish, prawn farming, striped bass, pond construction, cage culture and more.

For a set of the aquaculture columns, write UNC Sea Grant, Box 5001, Raleigh, N.C. 27650-5001. And, for more information on aquaculture, contact Foster at the NCSU Aquaculture Demonstration Project, Route 2, Box 305, Aurora, N. C. 27806 or call (919) 322-4054.



Fishermen in Brunswick, New Hanover and Pender Counties will have a new source of information waiting in their mail boxes soon. Jim Bahen, the Sea

Grant marine advisory agent in the Wilmington area, has published the first issue of his newsletter, *Light Line*, designed for commercial fishermen—gill netters, shrimpers, charter boat captains and more. The newsletter will offer news about research, advances in gear and methods, regulations, and programs and events of interest. If you don't receive a copy of *Light Line*, but would like to be added to the list, write the UNC Sea Grant Advisory Services, General Delivery, Kure Beach, N. C. 28449 or call (919) 458-5498.

Sea Grant agents Bob Hines and Larry Giardina also publish a newsletter for fishermen, marina operators, seafood dealers and others along the central North Carolina coast. To be included on their mailing list, contact the UNC Sea Grant Advisory Services, P. O. Box 896, Atlantic Beach, N. C. 28512, or call (919) 726-0125.

UNC Sea Grant will host a visit from Neil Armstrong, director of the Center for Water Resources Research at the University of Texas in Austin, to the North Carolina State University campus November 18 and 19.

*Continued on next page*



Armstrong, a recognized estuarine authority, has extensively researched the relationship between stream flow and estuarine productivity, a growing problem in North Carolina as more coastal lands are drained via ditches to the estuaries. Armstrong will speak to Lundie Spence's NCSU oceans class and present a seminar to the NCSU Department of Zoology. He will be available for prearranged private consultations on November 18 and for consultations with state water-management officials on November 19. If you would like to make an appointment to talk with Armstrong, call the Sea Grant office at (919) 737-2454.



For those folks planning fall trips to the North Carolina coast, don't forget to include a visit to one of the N. C. Marine Resources Centers. At the Roanoke Island center, a new wave tank exhibit will be on display in November. And field trips are planned to explore the salt marsh and to watch the fall migration of birds and waterfowl. For more information, call Hilda Livingstone at (919) 473-3493.

Every Saturday and Sunday at 3 p.m. during October and November, the Bogue Banks center staff will present a live sea creature program featuring such ocean and marsh notables as the blue crab, the hermit crab, the octopus and the oyster. Also on the agenda each Wednesday and Saturday during the fall is a children's story

time. Center staff will read from a selection of children's nature books. For more information about these programs, call (919) 726-0121.

And, if you're interested in foraging for your dinner, plan to attend the Wild Seafoods Day, October 30 at the Ft. Fisher center. Participants will gather seafood and plants from the marsh and beach, then prepare, cook and eat them. Preregistration is required. For more information, call (919) 458-8257.



Fishermen get your reels ready and your four-wheel drive vehicles packed. Surf-fishing season is here. Fall is the best time of year for surf fishing. Fish, fat from a summer in the estuary, are ocean-bound, often moving along the coast before swimming seaward.

And while surf fishing packs a lot of excitement, Leon Abbas, UNC Sea Grant's marine recreation specialist, says it can be hazardous too. Waves, the primary hazard, can knock a fisherman off his feet and fill a pair of chest waders in seconds. Unless the fisherman can free himself of the waders quickly, he can drown.

Abbas advises that a fisherman choose a spot where the water isn't too rough. Remember the surface under the water is not smooth. Holes, bars and trenches create varying depths along the bottom that aren't always detectable from the surface.

Fishermen should consider tide

changes. "What seemed to be a comfortable level when you waded out may change behind you," Abbas says. Fishermen also should keep an eye on the weather, watching for changes in wind direction or sudden storms.

Abbas suggests that fishermen carry only minimal equipment into the surf. Hand gaffs or knives should be covered or kept in sheaths.

And whether you're a novice or an old salt, don't go night fishing alone.

UNC Sea Grant mini-grant funds have been awarded to the North Carolina State University Department of Food Science to support a study aimed at developing a baby food made from fish. Laura Jane Mackintosh, a masters' candidate in food science, will be working to develop a new product that will be acceptable to mothers and babies. The National Fisheries Institute also will be contributing funds to the study.

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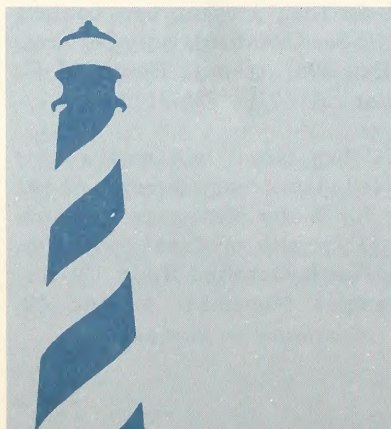
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## COASTWATCH

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# COASTWATCH

Photo by N. C. Division of Marine Fisheries



Photo by Neil Caudle



Photo by Jane Oden



*This month, Coastwatch looks at the changing role of women in commercial fishing. The traditional: partners in net-mending (top). And the new: Margaret Hopkins at the helm (left); Carol Teague stacking her crab pots (above).*

## Carol: spell it 'Fisherman'

The scene is a Dare County courtroom, and the lawyers are selecting a jury. One of the prospective jurors is a tall, blonde young woman who looks as though she might have acquired her tan on the tennis court.

The lawyer asks her name, address and occupation. Her answer raises a titter in the courtroom.

"My name is Carol Teague," she says. "I'm from Hatteras. I'm a commercial fisherman."

After some ado, the answer held up that day in court. But more importantly to Carol Teague, her claim to the title "commercial fisherman" holds up in Hatteras, where fishing ranks somewhere between love and death as a matter of consequence.

"I am a fisherman," she says, "and I mean *fisherman*. I'm not a fisherperson or a fisherette or any of those strange words. The word says what I do. I fish. The word has been around a long time, and it deserves respect."

She arrived in Hatteras eleven years ago, fresh out of Old Dominion University, with a friend who wanted to give island life a try. The friend didn't stick; Carol did. She liked the place, even though she did begin to tire of the questions she heard when she traveled off the island—questions such as, "What's a pretty girl like you doing stuck way off in a place like Hatteras?"

Her answer: "I love Hatteras. It's home. Everybody's got to have a home. Right?"

Hatteras was home for four years before Teague fell under the spell of

*Continued on next page*



commercial fishing. It happened the day a neighbor gave her 20 old crab pots.

"They were just falling apart," she says. "Nobody else would have tried to use them. But I rigged them up somehow, painted my buoys, and threw them out in the sound. The first day, I got one box of crabs and sold them for twenty dollars. At that time, I was making about fifteen dollars a day working in the general store. So I said, 'Man, I'm going to quit this store and get me a hundred crab pots.'"

And that's just what she did. Word drifted around to Wanchese and Manteo and Stumpy Point about a young woman with a little 13-ft. boat and a few rag-tag crab pots. In some of the stories, she was known as "Crab-Pot Carol." In others, she was "Crazy Carol." It took a while for word to get around that she was just Carol, the commercial fisherman.

Her first year crabbing, she shared the work with a friend who helped her learn where to set the pots, and when not to take a chance on the weather.

"I wasn't very smart about the weather," she says, "not the way they are in Hatteras. They've grown up with it; they can read the signs. I would just go out, and if I didn't see any other boats, then I started getting nervous."

Her second year, she had more pots and did the crabbing alone. She became a student of fishing. She questioned the old pros. She experimented.

"That year, the crabs moved on the backside of the reef, into deeper water. I'd never worked that kind of place before. I'd listen to everybody and then I'd make my own decision. To me, it was constantly trying to figure out how to catch more crabs—trying to get little bits of information each time I went out."

Some of her experiments tickled the Hatteras funnybone.

"When I first put those twenty pots out, they laughed out loud," she recalls. "But when I set out a hundred pots, they saw I was serious. When I came in with my first thousand-pound day, they were real proud of me. My little boat was full. There were crabs everywhere."

After that, Carol Teague was a respectable advanced beginner in the Hatteras school of practical experience. She had some good instructors there, she says.

"I really don't think the fishermen treat me special because I'm a woman," she says. "The thing down on the docks at Hatteras is that everybody helps



Carol Teague

everybody else out. I've had people come looking for me, when I've been out in the boat alone in rough weather, just to see if I'm all right. But they didn't do that because I'm a woman. They do just the same for any fisherman."

Few fishermen live out of their crab pots year-round, and Teague's boat has spent a lot of time tied up in Hatteras while she has been off drop-netting in the ocean, gill-netting in the sound, or hunting king mackerel on fall days offshore.

hook man." (Longlines are reeled aboard as the crew attaches or detaches buoys and hooks.) "Talk about excitement," she says, "it's pretty exciting to gaff a live swordfish and see him hauled aboard." She developed a knack for dressing billfish: "I'm a perfectionist about it," she says. "I like to see them cleaned and iced just right."

She's less enthused as she describes her bout with pound-netting, which, she says, demands more physical power than she can muster to handle the huge

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*"Every time I do go out, I learn something, and it doesn't matter if I'm crabbing or working a trawl boat. I learn. I learn about the wind and the water, and I learn where the fish might be."*

— Carol Teague

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She likes to talk big boats and long trips. Scalping off New England three summers ago was "wonderful," she says. "We were out to sea fourteen days at a time."

When she goes longlining for swordfish, Teague and two men take turns cooking and working the deck.

"I was the buoy man, when I was on deck," she says. "The other guy was the

stakes and heavy nets. But when it comes to sheer endurance, she says, she holds her own.

"Trawl-boating is very, very, very hard work," she says. "But if you put your mind to it, you can do it. One trip, we got seven hundred boxes of fish. We'd work for twenty hours straight, sometimes, and there would be times when I'd say, 'I can't make it.' Then one



of the guys would say, 'We're all thinking the same thing,' and that would help get me through it. Of course, your motivation is the money. If you're catching that many fish, you're making money. But you never know, when you go out, whether you'll find fish or not."

From time to time, she hears another version of that old question—the one that begins, "What's a pretty girl like you doing . . ." This version has to do with why a woman would dare go out to sea for days or weeks with a bunch of roughneck fishermen. She doesn't bat an eye, answering that one:

"The way they treat you depends on the way you act," she says. "I'm out there to work, and they know it, so they treat me like a worker, that's all."

"I've never been to sea with a captain I didn't have confidence in," she says. "The captains I've worked with are so good, they can even *think* like a fish."

Once in a while, she has a notion to be a captain herself. She even took a course, offered by Sea Grant, that she says prepared her for the Coast Guard's licensure exam.

"I would have passed the test, too," she says, laughing, "if I hadn't left in the middle of it to go scalloping off New Jersey. They called me that night, so I got on a plane. When you get a chance like that, you take it."

This fall, Teague has been a mate on Captain Ernal Foster's charter boat, *The Albatross*. Her job is to help with the gear and to keep sportsfishermen catching fish. She first worked for Foster six years ago, when she became the first woman mate in the Outer Banks fleet, according to Foster.

"He started me on the wheel (steering)," she says. "Any time you go out to sea, it's good if the captain knows his mate can get the boat in, if something

happens."

Sooner or later, the people she meets usually come around to asking if she plans to be a commercial fisherman all her life. That question worries Carol Teague a little. She is 31. She doesn't want to fish her life away, to wake up some morning weathered and worn out from all that hard work. Now and then, she thinks she might like a "straight" job, maybe even a family. But so far, nobody's tempted her into surrendering her fishing, her home or her freedom.

"I feel like I'll always have a few crab pots and go fishing now and then," she says. "I'm a worker. I like to work, and I like working on the water. Every time I do go out, I learn something, and it doesn't matter if I'm crabbing or working a trawl boat. I learn. I learn about the wind and the water, and I learn where the fish might be. That's the way my life is."

—Neil Caudle

## Margaret: an equal partner in family-style fishing

There's something of a family portrait in the arrangement of three boats tied up just outside Hopkins Seafood in Pamlico Beach. There against the far bank lies the old 27-foot trawler that Margaret and Murphey began married life on some 38 years ago. Here at the dock, a newer larger trawler is waiting for repairs. This boat, the *Libby and Robbie*, represents a second generation of Hopkins. In its shadow floats a tiny fibreglassed foam hull, battered and cracked. Its makeshift rigging holds a scrap of shrimp net. This is the third generation, a grandson's plaything.

"Soon as my little grandson comes home from school, that's where he wants to be, dragging that little shrimp trawl up and down the ditch," Margaret says. "I guess we've got fishing in our blood."

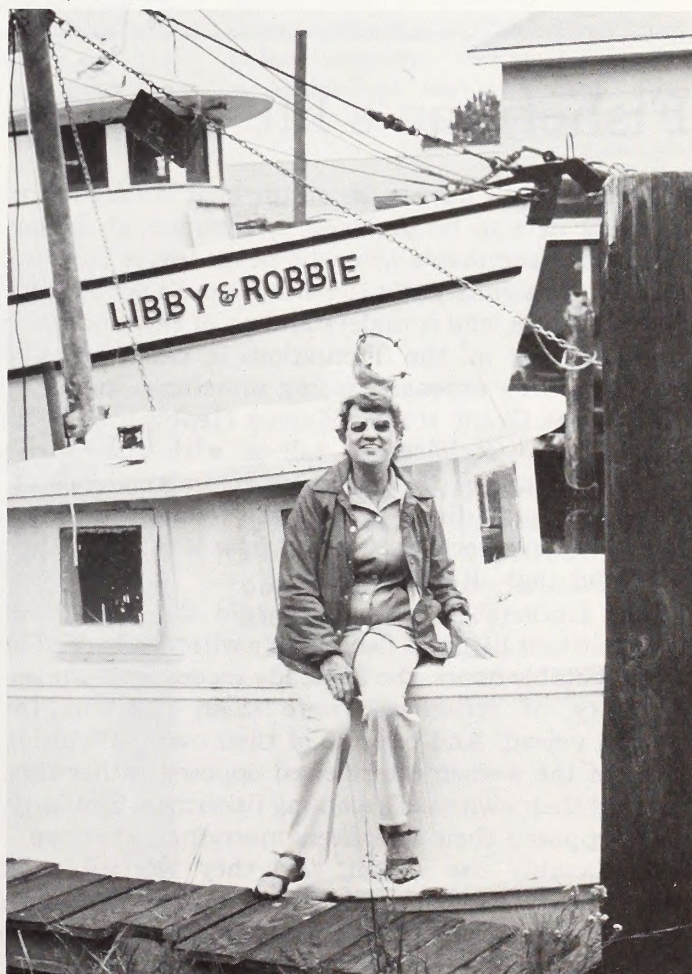
Fishing has always been part of the family for Margaret and Murphey Hopkins. She has been his equal partner in their seafood business, whether the job is dredging oysters, driving the truck or keeping the books.

She points to their old trawler.

"That boat over there, my husband had her when we got married. He bought her in January, we got married in May, nineteen forty-five. We've been out oystering on that, me and him together, when you'd pull the dredge in and the water would ice, right on the dredge, and stay right there. We've had her loaded down to where we couldn't put another one on her. I guess you could say it's been our life."

Margaret spends more time weighing crabs, culling

Photo by Neil Caudle



Margaret and boats from two generations

Continued on next page





Margaret and Murphey Hopkins

fish and keeping records than she does fishing.

It has never worried her to be the only woman on a boat. "In all the years I fished, no fisherman ever insulted me," she says. But she admits that she's had to remind crewmen of their manners once or twice. On one fishing trip a few years ago, she found some of the crew reading "girlie magazines."

"I asked them nice the first time," she recalls. "Then I had to *tell* them, 'Put those girlie magazines away.' But when I came back in after while, there they were out again, lying right there on the table. That was when the girlie magazines went swimming."

Margaret sees no reason why young women shouldn't aspire to be commercial fishermen, if they're willing to work. She says there's nothing unfeminine about fishing. Murphy agrees with her.

"I'd always rather have her on a boat with me than some man," he says.

Femininity, according to Margaret, is a matter of the mind.

"I have feminine thoughts," she says, "but I can do a man's work. And I love a boat more than any man ever loved a boat. Being out there on the water, well, it's better than a trip to the psychiatrist. It eases your mind."

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## Fisherman's life troubles wives who wait at home

Women don't have to be on the boat culling fish or mending nets to be involved in commercial fishing. Often the fisherman's wife who never leaves the dock contributes significantly to her husband's occupation. She is the one who is understanding of the long hours fishermen put in, the fluctuations in catch and pay and the heavy expenses fishing sometimes incurs.

In a Sea Grant study, Marcus Hepburn and Jim Sabella, two sociologists, talked with fishermen's wives at Harkers Island about commercial fishing. They wanted to find out how the women felt about their husbands' occupation and how it affected their lives and that of their family.

The Harkers Island women told the researchers they felt that life for a fisherman's wife was hard. The unpredictable hours, the unsteady income and the uncertainty of retirement were main concerns the women voiced. And because of their own difficulties, more of the women interviewed opposed rather than favored their own sons becoming fishermen. Similarly, more opposed their daughters marrying fishermen.

Predictably the women said they worried a lot about their husband's safety and nearly two-thirds wanted their husbands to limit fishing to day trips to "inside" (sound or estuarine) areas. Hepburn says the women's worries influence their husband's fishing ac-

tivities. Research has shown that men who work the offshore fishing boats for extended periods of time are typically younger, unmarried men. Older, married men tend to fish closer to home for shorter periods of time.

While the women may not be enthusiastic about fishing, they are supportive of their husbands. Many do the bookkeeping and file the taxes.

Among fishermen's families, the children tend to have greater contact with their mothers than their fathers because of the fisherman's long absences. And the more the fisherman is away from home, the closer his wife and children become to her side of the family.

Hepburn says most fishermen will marry women who have been exposed to the fishing culture. Usually their father, grandfather or close relative was also a fisherman. "A woman is not a fisherman's wife by happenstance," Hepburn says. "She usually knows what it is like to be a fisherman's wife. They are women prepared for the unique pressure of fishing."

"It takes a special woman to be a fisherman's wife," says Mary DeBoy, president of the Brunswick County Commercial Fishermen's Association. "You have to understand fishermen don't work by the clock. Their clock is the tides, the weather and what is out there to be caught."



# Social barriers don't stop women who fish

Lucille Truitt doesn't hesitate about closing the door on her junk shop in Oriental to go fishing with her husband, Billy. After living some 50 years on the banks of the Neuse River, Lucille feels at home on the water. She can smell a school of fish on the air and read the weather in the sky. She talks of mare's tails, mullet fishing and painting the thing she knows best—the river.

Billy, a commercial fisherman, says Lucille is good help when it comes to fishing. "I'd rather take Lucille fishing than any man I know," Billy says. "She always believes we're going to catch fish."

Lucille has pulled crab pots, shrimped and fished nets. She fishes alongside Billy on the couple's 30-foot boat, the *Sea Hound*. "Fishing was born into me," Lucille says. "I spent the first six years of my life on the river. We lived on an old flat my father pulled up and down the river. He fished for shad and my mother dried the fish and picked the fat-backs. We finally settled in Oriental when they had to put me in school. My mother says those days on the river were the happiest days of her life."

A sparkle comes to her eye and a smile spreads across her face as Lucille talks of fishing. "Mullet fishing is the best sport in the world," Lucille says. "Billy and I go out on dark nights before the moon comes up and we listen for the mullet to jump. We wait until we hear two or three. That usually means there's a pretty large school. We set the net and then start hollering, banging the side of the boat and slapping the water. Boy, the mullet start flying. One hit me right in the head last week. We had fifty jump in the boat and the net was loaded. We caught 23 boxes of mullet that night."

Lucille says Billy gives the orders on the boat. "He does favor me," she says. "He treats me like a woman. He's the boss on the water and I'm the boss at home."

Lucille says she hasn't received any flak from other men about her job on the water. And occasionally when another fisherman needs some help, Lucille abandons Billy to become first mate on another boat. "They all accept me as one of the boys," she says.

While Lucille loves fishing, she wishes it offered a more steady income. "You never know how much you're going to make," she says. "And things are worse

than they used to be. We're getting fifteen cents a pound for mullet, the same price we were getting fifteen years ago."

Lucille says she is seeing more women on the water these days. "More men are taking their wives," she says. "It's cheaper to train the wives than to hire help."

Today more and more women are taking to North Carolina's coastal waters to fish. Some women, like Lucille, help their husbands; others fish alone. And some women crew on large trawlers. But no one knows exactly how many North Carolina women are plying the waters in search of fish.

Barbara Jordan, a Belhaven crabber, says she loves the freedom fishing offers her. "It's great not having a boss looking over your shoulder," she says. "I go out there, work hard and make decent money. I couldn't stand putting forty hours behind a desk each week."

Barbara rises before dawn and cranks the motor on her 19-foot *Sea Ox* before covering 13 miles of Pamlico Sound. She pulls up every one of her 150 crab pots by hand, occasionally leaving her 116-pound body sore at the end of her run. "It's man's work," Barbara says. "But

women can do it. Women aren't as fragile as they used to be."

Barbara believes her career as a fisherman actually gives her more time for her family than a conventional job would. She's back at the dock most mornings by 10 a.m. with the rest of the day to call her own.

After eight years of fishing, Barbara says she feels confident on the water. "You can't go out there scared or something will happen to you," she says. "It takes self-confidence to fish just like it does to do anything else."

Ida Mae Kennedy can put most men to shame when it comes to clamming. On a good day, Ida Mae can rake 1500 clams in four hours. Only recently has open-heart surgery slowed her pace. Born in Shallote 70 years ago, Ida Mae has been fishing all her life. "If you take me away from fishing, I'd probably die," she says.

Ida Mae hasn't let being a woman stop her from doing anything she wanted to do. She's worked in factories, driven a city bus and hauled logs for a timber company. "I've never met any resistance from men or women," Ida

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*"Fishing was born into me. I spent the first six years of my life on the river. We lived on an old flat my father pulled up and down the river."*

*—Lucille Truitt*



Mae says. "They've always admired me because I was able to do the things I did. Besides, I hold my own doing any job. I don't take anything off anyone."

Marcus Hepburn, an East Carolina University sociologist, says social barriers may keep many women from becoming fishermen. Many fishing communities have restricted women to clamming, oystering and scalloping. But things are changing. Larger fishing vessels are more mechanized, taking much of the heavy work out of fishing. And some boats are equipped with separate facilities for women.

Debi Daniels, a Wanchese native who makes occasional offshore trips as a crew member for her brother, Steve Daniels, says the social barriers still exist. "It's all right for me to go fishing with my brother," she says. "But if I were to go out on another boat, people around here would talk. They think it's not a woman's place to be out there on the water with a group of men for a week or more at a time."

Yellow-tailing off the George Banks constitutes hard work, 22-year-old Debi says. She cooked, worked on deck, and operated the hydraulic net. She was paid the same wage as her male counterparts and a little more for cooking.

"I wouldn't recommend fishing for everybody," she says. "I went four days without a bath. There were a lot of times when I had to be on deck to cull fish for hours at a time. There wasn't much time for sleeping. I'd go back again though. It's fast money and I love to be on the water."

—Kathy Hart

Photo by Neil Caudle



Debi Daniels and Melodye Cannady, two fishermen from Wanchese

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, Box 5001, Raleigh, N.C. 27650.

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I am in the following line of work:

—Boatbuilding/Repair

—Marina operator

—City/County government

—Marine recreation

—Commercial fishing

—Mass media

—Educator

—Seafood processing/marketing

—Farming

—State government

—Homemaker

—University professor/researcher

—Lawyer

—Other \_\_\_\_\_

Coastal property owner ☐yes ☐no Boat owner ☐yes ☐no



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



It's not too late in the season for farming, especially if the crop is rainbow trout. And this year for the first time, Sea Grant aquaculturists and a Belhaven businessman are teaming up to help put prospective trout-farmers in business.

In May, Johnny Foster and Randy Rouse of Sea Grant's Aquaculture Demonstration Project in Aurora harvested their first crop of rainbow trout grown in brackish water off a pier in South Creek. While the fish grow best in waters between 38° F and 70° F—the normal range of water temperatures in the mountains—Foster and Rouse proved the pan-size trout can be raised in the state's coastal waters during winter.

Encouraged by their results, Doug Clark of Belhaven bought a truckload of tiny trout, 2580 of the 5-inch fingerlings. He's selling them complete with cage and feed for the winter growing season.

Foster hopes to get some help with his research from Clark's customers. "It's a way for us to get information from people other than researchers about raising fish. It'll be more representative of the general public," he says.

Foster will be checking with people who buy the fish to find out what problems they have, how they deal with them and what their final productions are.

Already, Clark has had calls from Roanoke Rapids to Wilmington. He recommends 250 fingerlings per cage.

With cage and feed, the cost is \$250. For more information, call Clark at (919) 943-2257, weekdays, and (919) 943-3346, evenings.

Why would 10,000 fishermen flock to a convention center in Baltimore? The answer: to see new gear, compare products, learn new fishing tips and visit with old buddies. The East Coast Commercial Fishermen's Trade Show will be held Jan. 21-23 in the Baltimore Convention Center in Baltimore. The convention, sponsored by the Maryland Watermen's Association, is geared toward small-boat fishermen.

Agents and specialists from the mid-Atlantic Sea Grant marine advisory services staffs will be conducting the seminars at the Expo. Bob Hines, the UNC Sea Grant agent at Bogue Banks, will give seminars on small-boat maintenance and on his experiments with anti-fouling treatments for crab pots.



The cure to that queasy feeling you get from tossing on the rolling sea may be stashed away in your spice rack. Ginger, used as a spice and as medicine for years, may replace the old treatments for seasickness, says Larry Giardina, a marine advisory services agent.

Two psychiatrists recently tested powdered ginger root to determine its effectiveness in preventing seasickness and found it to be twice as effective as dimenhydrinate, a drug often used to prevent motion sickness.

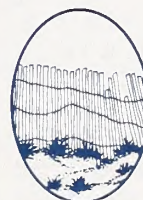
While ginger is available in powder form in grocery stores, doctors caution that it may burn the throat, Giardina says. They advise buying the capsule form which is available in health food stores.

The capsules come with a built-in dosage meter known as the "ginger burp," say the psychiatrists. They prescribe two to four capsules to start. If you haven't burped in about five minutes, take four more capsules. When

you burp after the last capsule, you've had enough.

So far, Giardina has seen no conclusive evidence that ginger is effective against seasickness. While some folks have tried the new remedy and still gotten sick, others have said they thought it worked, Giardina says.

He sees another problem testing the ginger cure: "If it works, there's no way of knowing if it was the ginger that worked or if you wouldn't have gotten sick anyway."



John Sanders, Sea Grant's coastal weather awareness specialist, traveled the Outer Banks between Hatteras and Corolla during the October 24th northeaster.

He would have gone farther north past Corolla, but his car wouldn't make it through the six to eight feet of sand that had washed over the roadway.

Sanders saw the worst flooding at Rodanthe and Waves where the storm left two feet of water standing in the streets.

Offshore from Hatteras at Diamond Shoals, weather service specialist Robin Seib reported winds of 60 to 70 mph with gusts up to 80 mph.

Farther south at Frying Pan Shoals, the National Weather Service reported windspeeds of hurricane intensity with sustained winds of 84 mph and gusts of 94 mph.

Even so, Sanders says this storm had two major differences from a hurricane. While a hurricane has a warm core (the temperature in the center of the storm), this storm's core was cold. And, on land, the wind velocity didn't reach the hurricane intensity of 74 mph.

"For those who've never been in a hurricane, they can see this storm . . . and get a better feeling for what a hurricane might mean," Sanders says.

"This particular storm happened very suddenly," he says, adding that

*Continued on next page*



residents had only about six to eight hours of advance warning. "Fortunately it was not of greater intensity. It's the type of storm you basically ride out because you don't have time to prepare for it."

Hughes Tillett, Sea Grant's marine advisory agent in Manteo, plans to take disability retirement December 1. Tillett became Sea Grant's second marine advisory agent when he joined the program in 1973. He has been instrumental in building a strong commercial fishing program, advising fishermen of changes in gear and fishing techniques. Sea Grant Director B. J. Copeland says he hopes Tillett's disability retirement is temporary and Tillett can return to the job when his recovery is complete.



UNC Sea Grant is bringing the classroom to the fishermen. Sea Grant has invited the Fisheries Mobile Unit from the Massachusetts Maritime Academy, a school for seamen, to conduct three day-long workshops for fishermen along the coast.

The first workshop, co-sponsored by the Southport-Brunswick Library, will be held Dec. 3 at the library. This workshop will focus on fish finders—how they work and which kinds to use. To register, call the Sea Grant office at Ft. Fisher (458-5498).

The next day the mobile unit travels

to Beaufort for a Dec. 4 workshop at the District Courthouse. This workshop, a survey of electronics, will cover marine radar, Loran C, fish-finders and more. To register, contact the Sea Grant office at Bogue Banks (726-0125).

The final workshop will be held Dec. 6 at the Seafood Industrial Park in Wanchese. It too will focus on electronics. To register, contact the Sea Grant office in Manteo (473-3937).

If you can't attend the workshops, you are still welcome to tour the mobile unit, view the video tapes and ask questions.

The new writer in Sea Grant's communications office is Nancy Davis. She will join Neil Caudle and Kathy Hart as a staff writer for *Coastwatch*, and will also help produce Sea Grant news releases, brochures and public service announcements. Davis, a graduate of the UNC School of Journalism, comes to Sea Grant from *The Raleigh Times*. She replaces Cassie Griffin, who resigned in September to accept a job in the public relations office of a computer software company in Cary, N. C.

Frank Thomas, project director for Sea Grant's Seafood Laboratory in Morehead City and a member of the North Carolina State University Department of Food Science, has been given the Earl P. McFee Award for excellence in the field of fishery technology. Thomas received the award during a September meeting of the Atlantic Fisheries Technological Conference in Portland, Maine.



This New Year's some coastal residents will be turning old Christmas trees into new dunes. If you'd like to join them, attend the third annual dune-repair and Christmas-tree-recycling program January 2. Bring only a natural tree, stripped of ornament, to the N. C. Marine Resources Center at Ft. Fisher for the 2:30 p.m. program.

Spencer Rogers, UNC Sea Grant's coastal engineering specialist, will lead the program along with help from the staff of the Marine Resources Center. Participants will take their trees to the Ft. Fisher beachfront to repair breaches in the dunes caused by pedestrian and vehicle traffic. Rogers says trees placed in the worn areas help trap and hold sand in their branches—creating a new dune.

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## COASTWATCH

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# COAST WATCH

Photo by Steve Murray



Sunrise at Core Banks

## Science with an eye for seas, sands and seafood

*Understanding anything as complex and everchanging as the North Carolina coast requires research. Research can be the key that unlocks the mysteries of the past, explains the changes of the present or solves the problems of tomorrow. Sea Grant is in the business of research. Every year Sea Grant sponsors research projects that answer to the problems and issues of the North Carolina coast—wastewater disposal, algae blooms,*

*shellfish contamination, innovations in seafood technology and more.*

*And with results in hand, Sea Grant reports back to the people—fishermen, landowners, seafood processors, fishery managers and others—through advisory agents, educational programs and publications. This year Sea Grant is sponsoring 22 research projects that will chip away at the problems nagging our coast.*



# Getting down to the nitty-gritty of building on sand

*The problem: predicting erosion rates and disposing of sewage in sandy coastal soils*

Sand. It moves, washes, blows and erodes. And it is not always the best soil under permanent structures or waste-treatment systems.

Many who own beachfront property risk loss or damage to their homes, either because of rapid beach erosion during storms, or because of long-term recession of the shoreline. In both cases, the loss of sand can mean undermined foundations, collapsing buildings. State officials are trying to find ways to protect both the property and the property owner. But they lack some key information about what parts of the shoreline are most vulnerable. Few reliable guidelines are available to predict how beachfront land might erode during severe storms.

Sand is also a culprit in the problem of sewage disposal. Conventional septic systems perform poorly where soils are porous and water tables are high. To compound the problem, the freshwater "lenses" that supply many of our barrier islands with drinking water may sometimes be tainted by effluent seeping through the soil. Island communities have often viewed alternatives to septic systems as either too expensive (ocean outfalls and central treatment plants) or too restrictive (outright bans on new construction). State agencies need hard facts to help them protect the quality of drinking water, and also the quality of nearby estuaries and shellfishing grounds.

*The research: to develop models that will predict erosion and to test alternative waste disposal systems in the shallow sandy soils of the barrier islands*

On the beachfront, John Fisher, Margery Overton and Spencer Rogers will study the problems of short-term erosion. So far, the complex interplay of storm waves, storm surge and sediments has not yielded to the tools of numerical "modeling." To develop such models, Fisher's team will compile erosion records from a number of barrier-island storms, and will use them to test and perhaps improve the formulas used now for predicting long-term erosion. The results will help state officials evaluate the level of risk for many coastal structures and building sites. The study will also help improve the design criteria builders and architects use for beachfront construction.

Sea Grant research into the problems of failing septic systems and the viral contamination of shellfish has already created something of an underground revolution in the Southeast. Research by Bobby Carlile led to the development of two "alternative" septic systems that often work where conventional systems fail, in the stubborn, wet clays along estuarine shorelines. Coupled with Mark Sobsey's studies of viral contamination, the research showed that effluent could be controlled and treated without endangering shellfish in nearby waters.

Photo by Steve Murray



*One beach losing sand*

Communities as far away as Texas now employ the designs to help solve their own waste-treatment problems. (Two manuals on the design of these systems are available from UNC Sea Grant.)

This year, continuing research by Craig Cogger, who assisted Carlile on the earlier project, is extending the study to the coarse and sandy soils of the barrier islands. Cogger is testing the designs, which employ low-pressure pumps to "dose" effluent evenly into shallow soils, to see how much vertical separation is required between the pipes and water tables. Meanwhile, Sobsey continues to monitor the sites, tracing the movement of harmful viruses through the soils. The results should help officials set guidelines for the use of so-called on-site treatment systems. And, some island homeowners may eventually have safer, more-effective waste-treatment systems.

## *The researchers:*

John Fisher, Department of Civil Engineering, North Carolina State University

Margery Overton, Department of Civil Engineering, North Carolina State University

Spencer Rogers, coastal engineering specialist, UNC Sea Grant

Craig Cogger, Department of Soil Science, North Carolina State University

Mark Sobsey, Department of Environmental Science and Engineering, University of North Carolina at Chapel Hill



## Mapping the way To a buried treasure

*The problem: information needed about the valuable minerals that lie buried on the continental shelf and how to extract them safely*

Much of our nation's wealth of fuels and minerals lies buried under ground and water on the continental shelf. The search for these treasures has already posed tough questions about how they can be tapped without severely disrupting the productivity and quality of coastal waters.

Sediments off North Carolina, for instance, contain important deposits of phosphate—a fundamental element in the production of fertilizers. But so far, the pattern and extent of these deposits are largely unknown. For this reason, assessing what impact mining them might have on North Carolina has so far been a matter of guesswork.

*The research: studies into the phosphate formations of Onslow Bay—where the largest deposits lie, how they were formed and how they relate to other formations*

Scott Snyder and Stan Riggs will begin a project designed to increase the understanding of phosphate formations in Onslow Bay, an area of nearshore waters cradled in the bow of land between Cape Lookout and Cape Fear. Previous studies by Riggs have already shown that significant phosphate deposits lie under the bay. But the team's new research will use sediment samples to extract answers for several key questions: When and under what conditions were these deposits formed? How do they fit into regional patterns of phosphate deposition? The answers will help geologists learn more about the formation of phosphates, and therefore what conditions are good phosphate predictors. Using the results, planners will be better able to determine where the greatest phosphate reserves might be, and which deposits should be more carefully explored—major steps toward an understanding of one of North Carolina's most valuable resources.

*The researchers:*

Scott Snyder, Department of Geology, East Carolina University  
Stanley Riggs, Department of Geology, East Carolina University

## The Legal Angle

*The problem: to answer tough legal and planning questions concerning coastal issues*

Agencies charged with regulating the use of North Carolina's coastal resources face a host of questions when they write or implement new policies. Many of these questions involve the complexities of law or community planning. They include such topics as ownership, access and public rights. Often, answering these questions demands more research than the agencies themselves can provide. And the problem is not only how to find the expertise to advise officials on the fine points of, say, the leasing of public bottomlands under public waters. It is also one of how to develop a pool of talent for the future, people well-versed in coastal issues and ready to take positions of leadership.

*The research: a study that answers to legal and planning problems while developing a pool of talent for the future*

For several years now, Sea Grant's program in coastal and ocean policy has produced both answers and new talent. The research, conducted by students in university law and planning programs, has helped state and federal agencies deal more effectively with such issues as public access to beaches, the establishment of estuarine sanctuaries, the use of submerged lands and methods for managing coastal development. And, a number of students have used the program to launch careers as leaders in the management of the state's coastal resources.

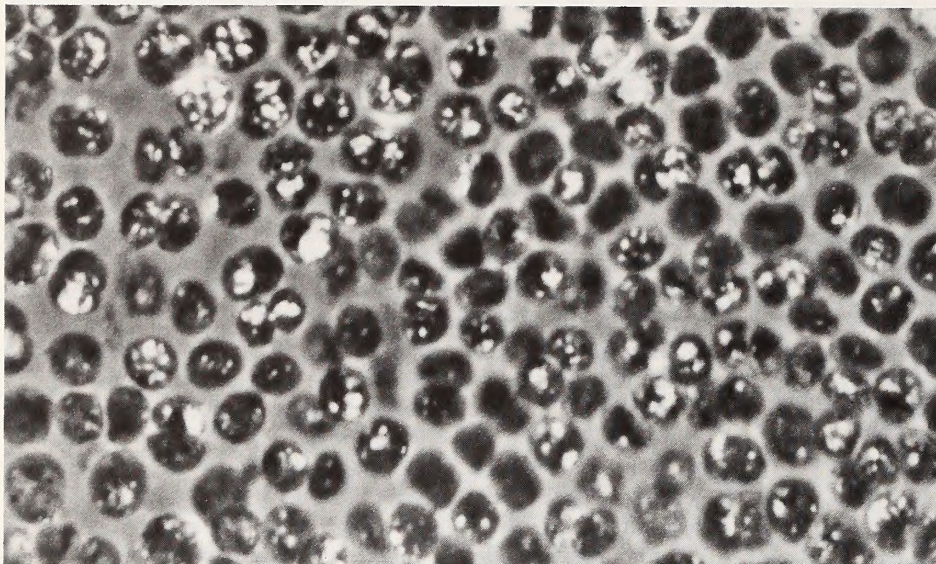
This year, David Brower will continue to encourage and direct law and planning students into research of immediate, practical value to coastal resource managers and planners.

*The researcher:*

David Brower, Center for Urban and Regional Studies,  
University of North Carolina at Chapel Hill







*Microcystis aeruginosa, under the microscope; Paerl sampling bloom-prone Neuse*

## Two new looks At a deadly bloom

*The problem: blue-green algae blooms on coastal rivers which may alter the ecosystems downstream in the estuary*

During the summer the pungent odor of decaying algae pervades the air along the Neuse River. The paint-like scum invades the river from Kinston to New Bern. Citizens, scientists, fishery managers and state officials are concerned about the blue-green algae blooms, hoping to prevent the problems occurring on the Chowan River, further to the north.

Scientists believe high levels of two nutrients, nitrogen and phosphorus, trigger the blooms. And the Neuse River is chocked full of nutrients. Known point sources of nutrients, such as city waste treatment plants and industry, dumped 2.37 million pounds of nitrogen and 1 million pounds of phosphorus into the Neuse in 1981. And no one knows the levels of nutrients that arrive in the rivers from non-point sources such as land run-off.

Earlier studies that focused on algal blooms on the Chowan will provide a foundation for research beginning on the Neuse. In a Sea Grant study begun last year, Hans Paerl studied how far into the Neuse estuary the blooms penetrated and how factors like salinity and nitrogen-availability limited the penetration. Donald Stanley and Robert Christian examined the factors that trigger algal blooms and the effects of reduced nutrient-loading on bloom formation in the Neuse River.

But Paerl, Stanley and Christian have just scratched the surface of a very complicated ecological problem. More research is needed to learn how these massive blooms affect the estuaries and subsequently the fisheries production downstream.

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*The research: studies into the chemical and biological fate of blue-green algae blooms in the estuary*

Upstream blue-green algae paints the river in a foul-smelling scum, making it unfit for recreation and, occasionally, fatal to fish. Downstream in the estuary no evidence of the bloom is evident. But beneath the water's surface, the decaying bloom may be causing drastic changes in the chemical and biological makeup of the estuary. And Paerl wants to find what kind of biological changes are occurring.

Zooplankton, a major food source for many developing fish and shellfish in the estuary, feeds on phytoplankton. But during the past five years the phytoplankton community, which serves as the base of the food chain, has undergone major change. Blue-green algae now makes up the bulk of the phytoplankton present in the lower Neuse River between May and September. And early studies indicate blue-green algae may not be a nutritional food source for zooplankton.

Paerl will be studying blue-green algae's impact on the food chain. He wants to find out if the zooplankton can digest the algae or whether they shun it, perhaps creating a break in the food chain.

The findings of Paerl's studies will not only reveal how the algae affects zooplankton food sources, but will also show how algae changes food sources further along the food chain. Today's algae blooms could have profound effects on tomorrow's fish and shellfish populations.

In a sister study, Stanley and Christian will be studying the chemical fate of blue-green algae blooms in the Neuse River estuary. They will be taking a special look at what happens as the blooms are carried downstream to where fresh water and saline water meet. Earlier studies indicated algae are intolerant of even low salinities. Biogeochemical changes are believed to cause the algae's intolerance. Stanley and Christian will be testing this hypothesis.

The research team will also study what happens downstream in the estuary after the algae decays. Blue-



green algae contains large amounts of carbon and nitrogen. Large blooms and their subsequent decay could significantly alter the carbon and nitrogen in the estuary. Such alterations could in turn upset the production and abundance of fish and shellfish.

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*The researchers:*

Hans Paerl, Institute of Marine Sciences, University of North Carolina at Chapel Hill

Donald Stanley, Institute for Coastal and Marine Resources, East Carolina University

Robert Christian, Department of Biology, East Carolina University

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## Two costly diseases

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*The problem: contaminated shellfish and red-sore disease in fishes*

Contaminated shellfish and disease-ridden fish are lost resources to North Carolina's fishermen. Fishermen are prohibited from harvesting contaminated oysters and clams. And fish stricken with diseases such as red-sore usually die or are unsellable to seafood processors.

Shellfish contaminated by discharges from sewage treatment plants, faulty septic systems, land run-off and boat waste discharges can carry serious viruses. Hepatitis A is one of the most serious viruses they transmit. Last year in the state of New York, forty people contracted hepatitis A after eating contaminated clams. Another 300 to 400 people came down with gastroenteritis. After finding a portion of the clams harvested from approved open waters, state health officials warned New Yorkers not to eat any raw shellfish. While the outbreak was limited to New York state, officials from the Center for Disease Control believe outbreaks may be occurring in other areas, yet going unreported.

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*The research: studies into how shellfish are contaminated with hepatitis A and how fish are afflicted with red-sore disease*

Being surrounded by vials of cultivated viruses might make some folks nervous, but for Mark Sobsey it's part of the job. Sobsey has been conducting Sea Grant studies into the detection, occurrence, survival and fate of enteric viruses and bacteria in shellfish since 1976. But his latest project focuses on a single virus—hepatitis A.

After a stint at the National Institute of Health in Bethesda, Md., Sobsey brought back to his Chapel Hill laboratory the ability to cultivate and assay hepatitis A. Until 1979 such cultivation was impossible and Sobsey's laboratory will be one of the few in the country capable of cultivation.

With his new knowledge in hand, Sobsey will be studying hepatitis A contamination in oysters and clams. He will be testing current detection methods to see if they accurately determine the levels of hepatitis A in shellfish and in the waters and sediments of their habitat. Scientists, including Sobsey, have questioned the accuracy of the present methods used to detect viruses in shellfish.

Levels of hepatitis A in shellfish may depend on how

much contamination is present in the water. Sobsey will be measuring this relationship as well as the relationship between levels of hepatitis A and other viruses and bacteria in the water and sediment.

Sobsey also wants to find out how fast oysters and clams take up and eliminate hepatitis A. Oysters and clams will cleanse themselves of contamination if they are placed in clean water. But factors such as water temperature and salinity may affect their rate of cleansing.

One hope for fishermen may be depuration plants where large quantities of contaminated oysters and clams can be placed in tanks of clean water to free themselves of their contaminants. Sobsey will be setting up a pilot-scale depuration system to study hepatitis A elimination.

While Sobsey concentrates on contaminated shellfish, Ed Noga will be studying red-sore disease in the fishes of the Albemarle Sound. Fisheries officials estimate that up to 20 percent of the commercially important fishes in the Albemarle Sound may be affected by red-sore.

Noga wants to find out what causes red-sore in fishes and what characteristics, either in the fish or its habitat, indicate an impending outbreak of the disease.

Learning more about red-sore could mean finding ways to control its outbreak. And the study will be the first step in building a veterinarian ability in this state to deal with the problems of disease in fish.

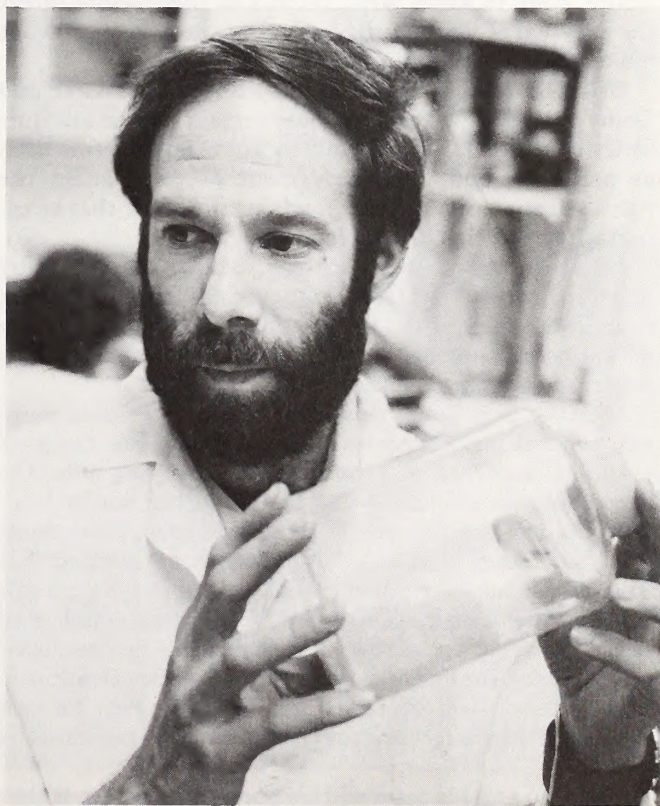
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*The researchers:*

Mark Sobsey, Department of Environmental Sciences and Engineering, University of North Carolina at Chapel Hill

Ed Noga, School of Veterinary Medicine, North Carolina State University

*Photo by Neil Caudle*



*Mark Sobsey with bottled virus*



# For a better harvest, Today and tomorrow

*The problem: scientific information needed so fisheries managers can make better management decisions*

Are North Carolina's fishermen overfishing the state's stocks of hard clams? Is the opening date for scallop season timed so that fishermen make the best harvest? Are valuable estuarine nursery areas adequately protected? These are the kinds of questions fisheries managers face every day. Managing wild stocks of fish for the good of all, managers must look out for today's harvest as well as tomorrow's. To do so, they need to know more about the resource as well as about the people who use it.

*The research: studies that will look into the biological, economic and social aspects of the state's fisheries, providing managers with a clearer idea of how their policies affect those they manage*

Nothing is more important to tomorrow's fisheries than estuarine nurseries. Kenneth McKaye and David Colby want to know what factors in the nursery affect the survival of young fish. And, they want to learn what makes an estuarine nursery a nursery.

Using laboratory and field experiments, McKaye and Colby will study why fish choose certain habitats as nurseries over others. They want to know how factors such as predation and water-movement patterns affect the fish's selection of a nursery, and, in turn, how that selection affects their chances for survival.

In answering these questions, McKaye and Colby hope to learn what factors distinguish a nursery area from other parts of the estuary. And arriving at a better definition of a nursery could help fisheries managers keep those nurseries productive.

McKaye and Colby won't be the only scientists probing the estuary; Charles Peterson and his team of graduate students will be there too, prying into the secrets of two mollusks—the clam and the scallop.

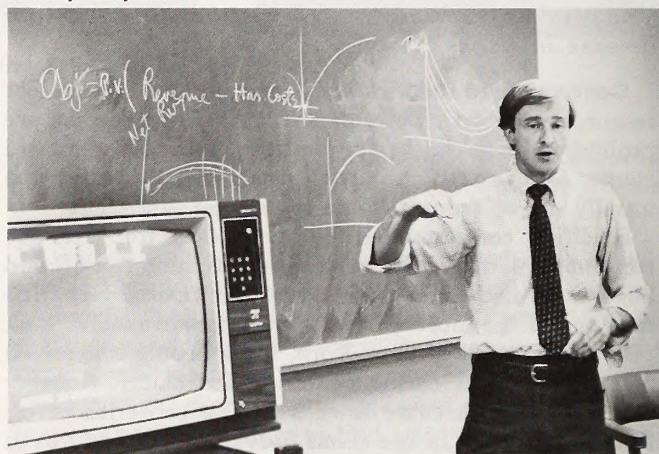
Fishermen are harvesting five times more hard clams today than they were in 1976. Managers are worried that this intense harvest will eventually take its toll on adult populations. And fewer reproducing clams could spell fewer clams for tomorrow. Using methods he developed to determine the age of clams in an earlier Sea Grant project, Peterson will be testing clams to see how harvest pressures have affected the clam's ability to replenish its numbers.

Peterson and his team will also be testing methods that

could be used to increase hard-clam abundance. During his first project, Peterson found that under predator-exclusion cages in sandy areas the number of baby clams that set and survived increased 20-fold. Peterson wants to test the cages in other habitats and determine their economic feasibility. If it is cost-effective, caging could become an alternative to clam hatcheries.

Testing seed-clam survival rates is another of Peterson's goals. Some fishermen plant seed clams (baby clams) on leased bottomland to assure themselves of a

*Photo by Nancy Davis*



*Jim Easley*

ready harvest. But a sure payoff can sometimes end in a pile of crushed shell if predators invade the beds. Peterson will be working with seed clams to see what combination of clam size, clam density, planting schedules, habitat and anti-predation measures are needed to maximize seed-clam survival.

Questions about another valuable mollusk, the bay scallop, will also occupy Peterson in the estuary. As an annual crop, the bay scallop fishery could be eliminated with a single harvest. Good management is crucial to the fishery's survival. Management plans call for a limited season with managers setting opening and closing dates to maximize the fishermen's harvest.

But present management schemes don't take into account bay scallop natural mortality rates, perhaps falling short of their goal to maintain stocks and maximize the fishermen's harvest. Peterson will study bay-scallop mortality, concentrating on the fall and winter months.

All fisheries research doesn't have to be done in the laboratory. Jim Easley, Ann McDermid and Tom Johnson do their work at the computer. They are using computer programs to test new fisheries' management policies before those policies leave the drawing board.

Business administrators use computers everyday to increase their company's profits or efficiency. Why not apply the same technology to fisheries management?



The research team will be plugging in a number of variables—fish growth rates, mortality, dockside values—so that managers can numerically “model” such problems as when to open shrimp season. The team will be modeling four fisheries—bay scallops, New River shrimp, hard clams and blue crabs in Pamlico Sound.

The computer won't untangle all the fisheries problems. But it can give managers a better idea of how their management schemes affect the resource and the people they manage.

Managing people means getting out the word about changes in seasons, gear restrictions or regulations to the fishermen who must abide by them. How do fishermen pass the word about regulations changes or a new piece of gear? That's what Jeffrey Johnson wants to find out.

He will be talking to fishermen to find out how they transfer information among themselves and how they seek information from other sources. Johnson wants to know if certain fishermen are looked to as innovators and information sources. And he'll want to find out what makes a fisherman a leader—age, education, fishing success or wealth.

Johnson's findings will be particularly helpful to Sea Grant marine advisory agents who try to keep fishermen abreast of the latest changes in fishing gear, markets and safety equipment. And a fisherman equipped with the latest fishery innovation may just bring a few more fish back to the dock.

And it's not just commercial fishermen who use the resource. What about the thousands who fish for fun? Peter Fricke, Leon Abbas and Jim Sabella have been finding out more about the recreational angler who fishes the North Carolina sounds. And this year, the team will be completing a study started in 1981. They want to

know how many fishermen use the state's sounds, what they fish for, how they fish, where they fish, how much money they spend, what their attitudes are toward fisheries management and more. Using the team's findings, fishery managers will know which recreational species are in greatest demand and how great the demand is. The findings can also be used by local and regional governments to plan for boat ramps, access areas and zoning regulations that promote the economic activities that surround recreational fishing.

#### *The researchers:*

Kenneth McKaye, Duke University Marine Laboratory,  
Duke University

David Colby, Southeast Fisheries Center, National  
Marine Fisheries Service

Charles Peterson, Institute of Marine Sciences, Univer-  
sity of North Carolina at Chapel Hill

Jim Easley, Department of Economics and Business,  
North Carolina State University

Ann McDermed, Department of Economics and  
Business, North Carolina State University

Tom Johnson, Department of Economics and Business,  
North Carolina State University

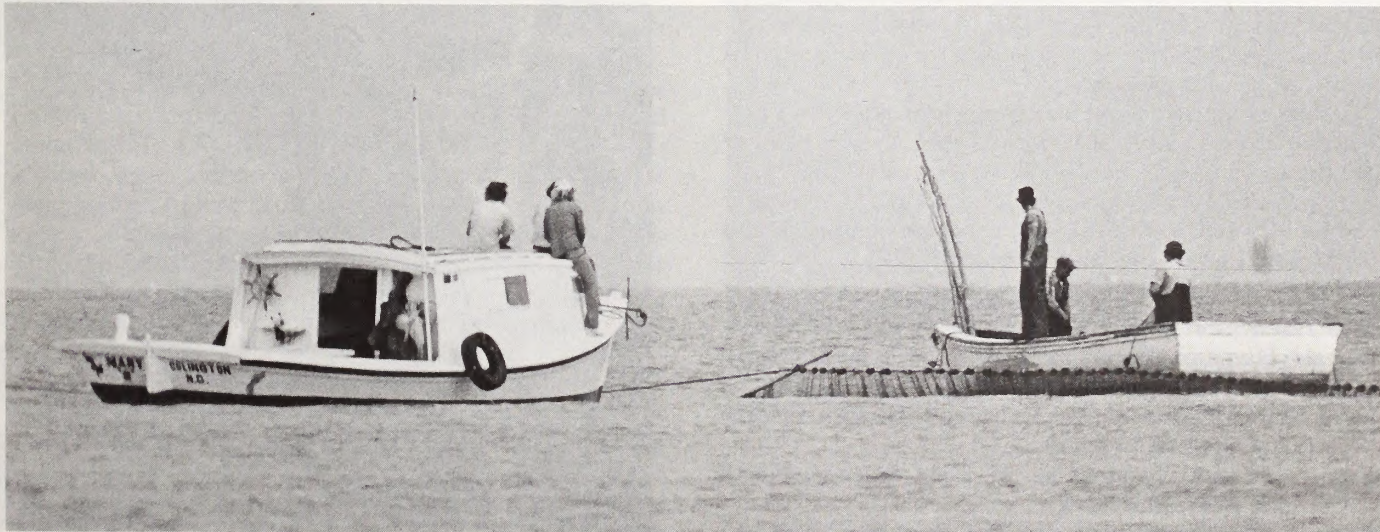
Peter Fricke, Institute for Coastal and Marine  
Resources, East Carolina University

Leon Abbas, UNC Sea Grant, North Carolina State Uni-  
versity

Jim Sabella, Department of Sociology and  
Anthropology, University of North Carolina at  
Wilmington

Jeffrey Johnson, Institute for Coastal and Marine  
Resources, East Carolina University

*Photo by J. Foster Scott*



*Longhauling in Dare County: Managing fisheries sometimes means managing fishermen*



# Menhaden worth more Than chicken feed

*The problem: how to get underutilized species of fish on the dinner table*

In 1981, North Carolina fishermen caught over 309 million pounds of menhaden, a fish used mainly for fertilizers and chicken feed. Each pound of menhaden brought fishermen less than 3 cents.

There are other underutilized species like the menhaden. If researchers could devise a way to process these fish into an edible form, the traditional seafood industry in North Carolina could expand. Researchers want to determine how to process the fish, what species to use and what to do with all the wastewater generated by the process.

*The research: developing a washed minced fish product using underutilized species that can be reconstructed into seafood products, and developing a system for dealing with the wastewater from seafood processing*

For years the Japanese have prepared a refabricated product of minced fish called surimi. By water-washing the mince, they end up with a protein concentrate suitable for use in restructured seafood products.

This year, Sea Grant will continue its work with surimi. Since mince depends upon a gelling agent to bind it into simulated shellfish products, Don Hamann and Tyre Lanier will be investigating the protein interactions which occur during gelation of fish proteins. Along with this, they'll be looking at the textural qualities of the simulated shellfish meats. For the consumer, this research could mean a fish product high in food value but low in cost.

Frank Thomas and Lanier will evaluate various underutilized species, particularly menhaden and other fishes in the Atlantic and Gulf of Mexico, for use in the production of surimi. They'll be developing handling, processing and storing techniques for the surimi prepared from the various species.

The washing technique necessary to make surimi presents additional problems. Where does the wastewater go? Allen Chao will be developing a wastewater treatment suitable for seafood processing plants. If the water can be recycled, it will save money for the industry and avoid pollution of the coastal waters.

## *The researchers:*

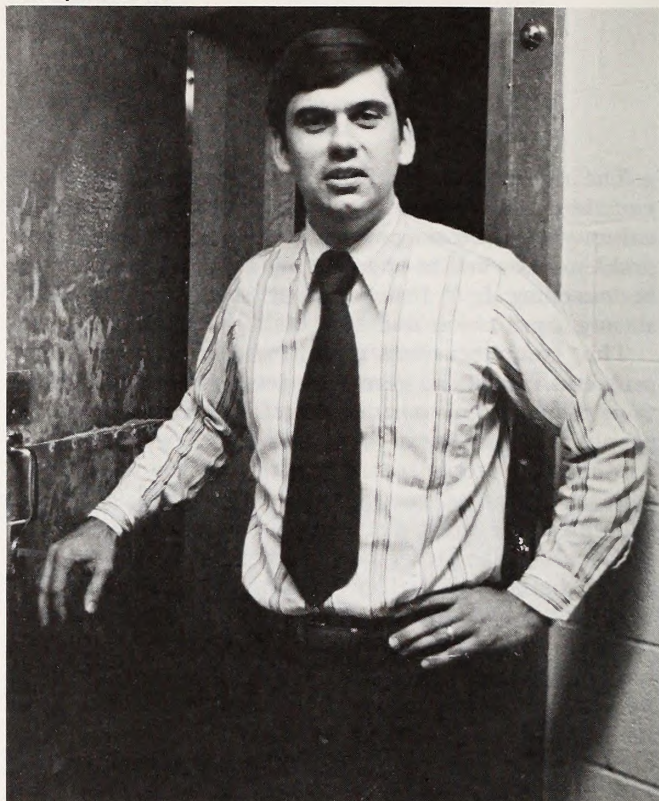
Donald Hamann, Department of Food Science, North Carolina State University

Tyre Lanier, Department of Food Science, North Carolina State University

Frank Thomas, Department of Food Science, North Carolina State University

Allen Chao, Department of Civil Engineering, North Carolina State University

Photo by Neil Caudle



*Tyre Lanier*

Photo from National Marine Fisheries Service



*Fishermen corralling menhaden*



# Using sun to stretch The aquaculture season

*The problem: developing a year-round aquaculture industry based on species that are feasible and economical to grow*

Aquaculture, like farming, is a seasonal business in North Carolina. But if year-round fish farming were possible, the way would be open for a new aquaculture industry here.

Although the state has numerous sites where aquatic farms could locate, so far only a limited amount of private capital has been invested in aquaculture. With a growing-season of only seven to eight months in outdoor pools and ponds, aquaculturists face the possibility of shutting down during the winter months. Moving culture operations inside is one solution but the cost of heating large volumes of water is generally prohibitive.

And, not all species are economical to culture. Aquaculturists need to know what species to culture and how to produce those species with the lowest possible costs.

*The research: studies into developing a passive solar greenhouse for year-round culture, developing hardier species of fish for culture and creating low-cost nutritional feeds for fish*

Because of the advantage of culturing fish year-round, Sea Grant is developing a passive solar greenhouse that will store the heat it collects during the day. "We want to demonstrate that it will work and that we can have year-round aquaculture in a temperate area like North Carolina," says Ron Hodson, project director.

Herbert Eckerlin will design and construct the greenhouse at the Sea Grant Aquaculture Research and Demonstration Center near Aurora, N. C.

Since water serves as the main heat sink for the greenhouse, Albert Rubin will design a recirculation system to maintain water quality and to reduce heat loss. Once the greenhouse is completed, Sea Grant will stock it with striped bass hybrids or American eels to test its efficiency. Larry Giardina will provide advice for making an economic analysis for the greenhouse.

But, even a greenhouse isn't enough to make aquaculture into an industry. Now, you need a crop. This year, Howard Kerby and Mel Huish continue their work with a striped bass hybrid. The striped bass is a prized sport fish as well as a highly desirable commercial species, but its populations have declined in recent years. Previous studies showed the hybrids were hardier than

the striped bass and raised the possibility of growing the fish for commercial sale.

The establishment of an aquaculture industry will also depend on a low-cost nutritional feed for the fish. Margie Gallagher will study the effects of protein-energy ratios in the diets of cultured fish. By finding out what kind of use the fish make of their food, Gallagher will determine which foods can best support the growth of fish raised commercially.

## *The researchers:*

Ronald Hodson, Associate Director, UNC Sea Grant College Program

Albert Rubin, Department of Biological and Agricultural Engineering, North Carolina State University

Larry Giardina, Marine Advisory Services agent, UNC Sea Grant College Program

Howard Kerby, Department of Zoology, North Carolina State University

Melvin Huish, Department of Zoology, North Carolina State University

Margie Gallagher, Department of Home Economics and the Institute for Coastal and Marine Resources, East Carolina University

*Photo by Howard Kerby*



*Curry Woods samples striped-bass hybrids in pools at Aurora lab*



# How freshwater in big doses threatens fisheries

*The problem: freshwater drainage into saline estuaries*

Coastal lowlands, once thought to be wastelands of soggy mire, are being cleared and drained at an increasing rate. Farmers have learned that drained wetlands can be among North Carolina's most productive agricultural acreage.

The water drained from these wetlands usually ends up in the estuaries, and can affect nursery areas for most of the state's commercial and recreational fishes.

Scientists, resource managers, fishermen and others are worried the freshwater influx is affecting the makeup of the estuaries (salinity levels, turbidity and nutrient levels) and in turn affecting fisheries production.

*The research: studies to measure the volume of freshwater influx, changes in salinity and the effects on fishes*

Three new UNC Sea Grant projects will study land drainage, focusing the efforts of scientists from different fields to provide the missing links in the land drainage-estuarine knowledge available.

Wendell Gilliam and Wayne Skaggs will be examining the rate of freshwater influx into the estuaries. They will measure the rate and volume of freshwater flow from drainage ditches into the estuaries over a variety of conditions—soil type, rainfall, canal construction. The team will also be looking at different ways for farmers to drain land while minimizing the effects of drainage on the estuaries.

Len Pietrafesa will be using Gilliam and Skaggs' findings to study the effects of drainage on salinity patterns in the estuary. In turn, John Miller and Jim Reed will be examining the effects of salinity changes on the production of juvenile fishes and shrimp in the estuary.

(Watch for more on the land-drainage problem in future issues of *Coastwatch*)



*Drainage canal under construction*

## *The researchers:*

J. Wendell Gilliam, Department of Soil Science, North Carolina State University

R. Wayne Skaggs, Department of Agricultural Engineering, North Carolina State University

Len Pietrafesa, Department of Marine, Earth and Atmospheric Sciences, North Carolina State University

John Miller, Department of Zoology, North Carolina State University

Jim Reed, Department of Zoology, North Carolina State University

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, Box 5001, Raleigh, N.C. 27650.

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\_\_\_ Marina operator

\_\_\_ City/County government

\_\_\_ Marine recreation

\_\_\_ Commercial fishing

\_\_\_ Mass media

\_\_\_ Educator

\_\_\_ Seafood processing/marketing

\_\_\_ Farming

\_\_\_ State government

\_\_\_ Homemaker

\_\_\_ University professor/researcher

\_\_\_ Lawyer

\_\_\_ Other \_\_\_\_\_

Coastal property owner \_\_\_yes \_\_\_no Boat owner \_\_\_yes \_\_\_no



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



Cold water can be a killer no matter how well you swim. The loss of body heat is probably the greatest hazard to the survival of a person in the sea because water cools the body 25 percent faster than air. As the body's core (inner) temperature begins to fall, the victim experiences the condition called hypothermia. Signs of pain, tiredness, poor coordination, numbness, poor speech and mental confusion appear. When the core body temperature falls below 90° F, the victim becomes unconscious. At 85° F, heart failure occurs.

Your survival in cold water depends on several factors including water temperature, body size, body fat and activity in the water. For example, fat people cool more slowly than thin people, and children cool faster than adults. Whatever the factors, there are some steps you can take to improve your chances of survival until you're rescued.

Don't swim. A person cools 35 percent faster by swimming. Instead, keep your head and neck above water. If you're wearing a life vest, assume the fetal position, or if there is another person in the water, huddle together. If you're not wearing a life vest, tread water just enough to keep your head above the water. And remember, your will-to-live will make a difference. Keep a positive attitude about your rescue.

To treat a hypothermia victim, re-warm him carefully. Do not massage his arms or legs since cold blood could flow to the core, further lowering the

body temperature. Move the victim to shelter and warmth as soon as possible. Apply warm, wet towels to the head, neck, groin, chest and abdomen. Again, do not heat the arms or legs. If a victim needs cardiopulmonary resuscitation, place him on a hard, flat surface. All hypothermia victims should be seen by a doctor.

Even if a victim appears drowned, administer heart massage and mouth-to-mouth resuscitation. Cold-water drowning victims have a good chance of survival.

For more information on cold-water drowning, write Sea Grant, Box 5001, Raleigh, North Carolina 27650-5001. Ask for *Cold Water Drowning: A New Lease on Life*.



A new 90-foot weather tower is operating at the N. C. Marine Resources Center at Ft. Fisher. Since December, fishermen from as far as 55 miles offshore have

been reporting back sea conditions to Sea Grant staffers at the center via VHF radio (Channel 68). In turn, the Sea Grant staff passes the information along to the National Weather Service office in Wilmington where the reports are incorporated into the marine weather forecast and broadcast over the 24-hour National Oceanic and Atmospheric Administration (NOAA) weather radio.

All this adds up to the Marine Weather Relay Program (MAWREP). And it means fishermen are helping predict sea conditions, and improving weather forecasting for offshore areas. They won't waste valuable time and fuel if conditions are too rough for fishing.

John Foster at the Sea Grant Aquaculture and Research Demonstration Center is compiling the annual lists of elver harvesters and buyers. The aquaculture center itself is on the list of interested buyers of the baby eels. If you'd like to be added to that list or to

the list of sellers, call (919) 322-4054 or send your name, company name, address and telephone number to: John Foster, Sea Grant Aquaculture and Research Demonstration Center, Route 2, Box 305, Aurora, N. C. 27806. Indicate whether you plan to sell or buy elvers.

If you're on a list, you will automatically receive copies of both. If you're not, you can request copies from the same address.



The third annual SEAS (Southeast Atlantic States) Diving Conference and Underwater Film Festival will be held in Raleigh, Feb. 25-27 at the Radisson

Plaza. The conference includes workshops on diving-accident management, sharks, wreck diving, fish printing, seafood preparation, the Atlantis III Project, diving on the Andrea Doria, fish-and-shell identification and more.

A Saturday evening film festival will be presented in Memorial Auditorium featuring Jack McKenney, an underwater cameraman, film producer, stuntman, writer and photographer.

And you'll be able to check out exhibit booths displaying the latest in scuba diving equipment, underwater photographic gear and diving resort areas in the Caribbean.

The conference is co-sponsored by UNC Sea Grant, the N. C. Office of Marine Affairs, N. C. Marine Education and Resources Foundation and N. C. Wreck Divers Association.

For registration information, write SEAS '83, P. O. Box 31186, Raleigh, N. C. 27622, or phone (919) 733-2290.

Mini-grant funds have been awarded to Alan Stutts and Chrystos Siderelis of the NCSU Department of Recreation Resources Administration and Leon Abbas, UNC Sea Grant's recreation specialist, to study public policy concerning recreational boaters.

*Continued on next page*



The number of recreational boaters has been steadily increasing in North Carolina, creating greater demands for access ramps and public docking facilities as well as demands on the environment.

Stutts, Siderelis and Abbas will use boater registration forms and group interviews to find out more about North Carolina boaters. They will also be looking at the state's present policies for handling boaters and the policies used in other states. The proposed work should help policymakers make better decisions about managing boater congestion, activity, conflicts and environmental impacts.



Winter weather is rough on skin and it's a special problem for fishermen. Wet hands and cold, dry air mean cracked, scaly skin—skin that is susceptible to infection. For years fishermen have dipped their hands and work gloves in bleach to kill the bacteria and fungus that can enter the cracked skin.

But this only dries the skin more, says Jim Patterson, a Burlington dermatologist. Instead of the bleach, he recommends a mild solution of betadine or peroxide. Then mix a quart of water with a few capfuls of bath oil and soak your hands for about 15 minutes. Follow with a heavy lotion or cream to trap the moisture in the skin.

Faces also need extra care in cold weather. For a case of windburn, wet a washcloth and place it over your face for a few minutes to soothe the skin. Then apply the same lotion as you do to your hands. And for chapped or cracked lips, use lip balm frequently.

Always consult a doctor if sores or rashes persist.



*Modeling the Relationship between Catch Biomass and Revenue in a Regional Setting with an Example from the Brown Shrimp Fishery in North Carolina*, by Marc-david Cohen and George S. Fishman in the Curriculum in Operations Research and Systems Analysis at the University of North Carolina at Chapel Hill, develops models for evaluating the impact of fishery management decisions on catch biomass, revenue and profit.

For a copy of this 72-page publication, write UNC Sea Grant, Box 5001, Raleigh, N. C. 27650. Ask for UNC-SG-WP-82-3. The cost is \$2.25.

UNC Sea Grant's share of the 1983 federal budget will be \$1,175,000, approximately the same amount of funds received in 1982. Director B. J. Copeland says he is pleased with UNC Sea Grant's allotment, especially in light of recent cutbacks in other federal programs.

John Doughty, a manager with the Weyerhaeuser Real Estate Company in New Bern, credits two Sea Grant specialists with saving his firm \$25,000. The company was planning a waterfront, second-home community complete with a 200-boat marina for its residents.

Since the firm didn't have much experience with waterfront development, Doughty called on Leon Abbas, Sea Grant recreation specialist, and Spencer Rogers, Sea Grant coastal engineering specialist, to provide a little know-how. They made suggestions on dock layout, parking and access—all which made the company's project more acceptable to regulatory agencies, Doughty said.

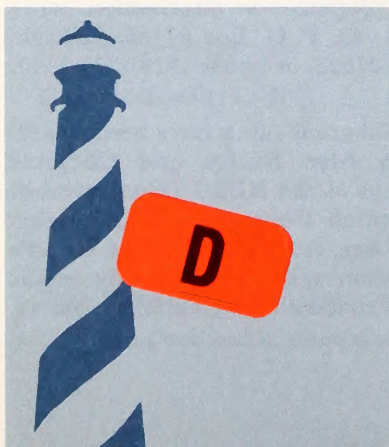
With the help of Abbas and Rogers, the company "saved time and money ... and provided a sound economic product that is sensitive to the environment," says Doughty.

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## COASTWATCH

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# COASTWATCH

Adapted from map by Minerals Management Service

## Oil and gas

They may be hidden off the coast of North Carolina. Oil companies say that the odds of finding them at all are slim. Even so, those companies are gambling hundreds of millions of dollars on leases. Their geologists sniff oil in the form of an ancient reef, buried over a hundred million years ago. The federal government is selling chances at this reef to the highest bidders. And map-makers have drawn an unruly stretch of open ocean into a checkerboard of leasing tracts—a checkerboard upon which the oil companies and the government have already begun to play. Test drilling may begin as early as this year, on some tracts.

Are there risks? Industry representatives assure coastal residents that oil and gas won't disrupt their lives or mar their beaches. But state officials are taking a hard look at some leasing tracts nearest the shore—where the drilling might be a little too close for comfort.

This month, in the first of a two-part series, Coastwatch looks at oil and gas exploration off North Carolina—who's involved, what's at stake, and what it is about our Outer Continental Shelf that's attracted all the attention.

In the next issue, Coastwatch will examine the risks of oil spills, and what's being done to offset them. We'll also take a look at how the costs and benefits of offshore oil and gas production might stack up for North Carolina.



Three-mile-square tracts for oil leasing: some are too near to suit state

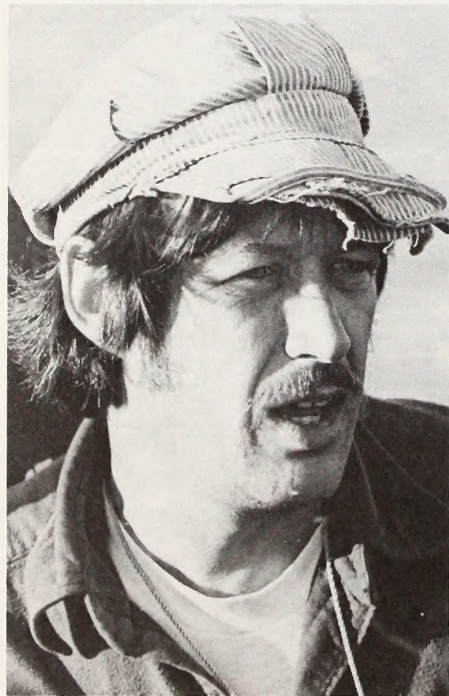


# Companies gambling there's oil in buried reef

Massive steel rigs loom like vultures over the Texas landscape, Alaska's Prudhoe Bay and California's Santa Barbara coastline drawing up long sips of black crude to quench a nation's powerful thirst for petroleum—oil that is, black gold, Texas tea. Most of America runs on oil and its byproducts. Over one-third of that oil is produced by foreign nations, many of which are politically unstable. And dwindling reserves of domestic oil and gas are sending companies in search of new frontiers for exploration. North Carolina's outer continental shelf holds the promise of being a new frontier.

Angela Waldorf, associate director of the North Carolina Petroleum Council, says the chances for finding commercial quantities of oil and gas are about one out of 50 in a wildcat area such as North Carolina's outer continental shelf, where no test wells have been drilled. Several of the nation's leading oil companies feel the odds are good enough, though, and they are plunking down millions for leases on the nine-square-mile tracts, and may spend millions more for exploration. Chevron USA Inc., the U.S. Subsidiary of Standard Oil of California, is the first in line to drill. Chevron bought in on 12 tracts during Lease

*Photo by Simon Griffiths*



*Stan Riggs*

Sale 56 held in August 1981. And R.L. (Bob) Woodard, Chevron's division exploration manager for the northern division, says the company hopes to begin drilling in 1983 on a tract off the northern North Carolina coast.

Secretary of Interior James Watt wants to hasten the exploration and development of oil and gas reserves along the nation's outer continental shelf. He has sped up the leasing process and has sometimes sold leases at bargain-basement prices (that's in oil company scale-of-economy where a few hundred thousand dollars for a lease is cheap) to lure oil companies to the shelf, where it is estimated that 25 to 33 percent of the undiscovered reserves of oil and gas in the U.S. are waiting.

The bait luring oil companies like Chevron, Atlantic Richfield and Gulf to North Carolina's outer continental shelf is about 190 million years old. It's an elongated basin off the North and South Carolina coasts that geologists call the Carolina Trough. But it's not the trough itself that has the oil companies bidding millions of dollars for leases. Stan Riggs, an East Carolina University geologist and UNC Sea Grant researcher, says it's the features within the trough, a Jurassic reef and salt domes or diapirs.

Riggs says four ingredients are needed to produce oil or gas. The first and main ingredient is organic material—dead plants and organisms. Then the organics must be transformed or cooked into oils and gases by the right temperatures and pressures. The wrong combination of temperature and pressure could mean coal instead of oil. Once formed, the oils and gases need to be able to migrate through porous sediments to reservoirs or holding rocks where they are trapped and held.

Geologists believe the trough, created during the rifting and stretching that occurred as Africa and North America split during the Triassic period, may have made a suitable caldron for oil and gas. Approximately 39,000 feet of sediments have accumulated in the trough, leading geologists to believe adequate pressures were present for the cooking. The mounting sediments may have also been heavy enough and permeable

*Photo courtesy of American Petroleum Institute*



*Drilling in Alaska's Prudhoe Bay*

enough to squeeze the oil and gas from the trough into nearby storage structures such as the Jurassic reef.

Old coral reefs are particularly good sites for oil and gas exploration. When alive the reefs were prime collection points for large amounts of organic matter. And as they died and sank under the weight of accumulating sediments, the reefs made excellent storage bins. Their grainy makeup creates plenty of pores for the oil and gas to collect in, says Riggs.

But the reef must be sealed if the hydrocarbons are to remain trapped. The Jurassic reef off North Carolina is capped with fine-grain limestone capable of sealing in oil and gas.

Other geologic structures of interest along the shelf are 21 salt domes or diapirs found seaward of the Jurassic reef. Salt domes in the Gulf of Mexico have yielded large quantities of oil. The salt domes, like the reefs, are collection and storage areas. But Waldorf says oil company interest, for now at least, is in the reef and not the domes.

Geologists such as Riggs and Barry Drucker, a staff geologist with the U.S. Department of Interior's Minerals Management Service, believe the reef offers the best possibility for oil exploration along the East Coast. But no



one expects another Prudhoe Bay off the North Carolina coast. The draft Environmental Impact Statement issued for Lease Sale 78 estimates (based on U.S. Geological Survey information) that if the area leased is hydrocarbon productive, a mean total of 228 million barrels of oil and 860 billion cubic feet of natural gas may be discovered. In 1980, Americans used over 15 million barrels of oil a day—more than a fourth of the worldwide production of 60 million barrels a day.

But Waldorf is hesitant to put much stock in estimated production rates. "We won't know what's out there until we drill," she says. But she points out oil companies are willing to put out millions of dollars to buy leases (as a

consortium Mobil, Amerada Hess and Marathon Oil paid over \$103 million for a single tract) to find out. And she estimates to explore a lease will cost another \$25 million per exploratory well.

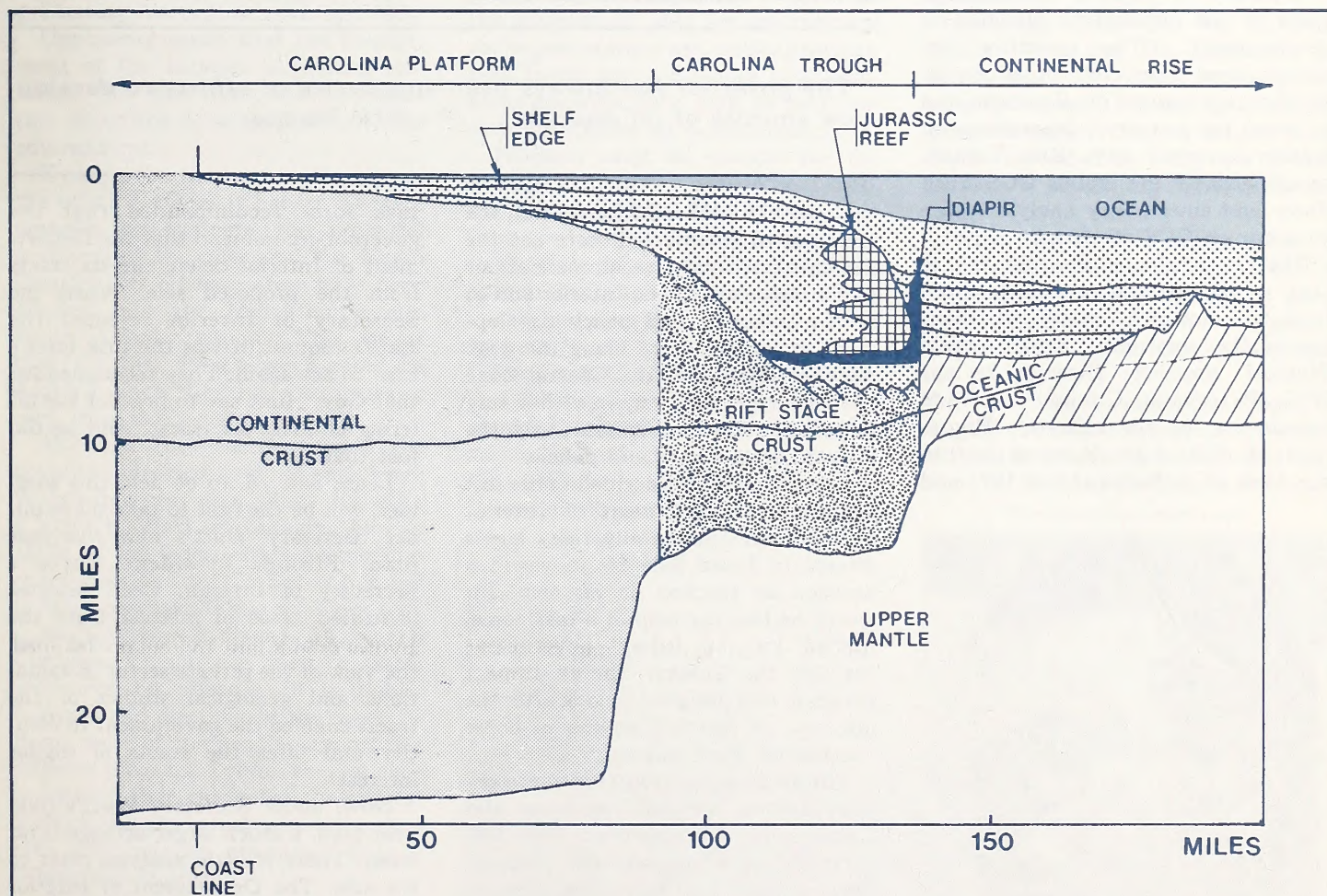
But even if oil and gas are discovered it would be another 10 years before actual production would begin, Waldorf predicts. And she stresses that substantial quantities of oil and gas would have to be found to justify the high cost of production—\$160 million to build a platform and \$1 million a mile to build a pipeline to transport the hydrocarbons landward.

And the possibility remains that nothing will be found. Six wells drilled in the Georgia Embayment turned up

dry. But sediment layers there were shallow. Waldorf says even if the first Chevron well is dry, the geologic information gleaned from the attempt could direct future drillings to more profitable areas.

Right now geologists and oil companies are depending on seismic studies to direct their exploration. Drucker and Riggs say there is a greater likelihood of turning up gas than oil. Riggs says gas is more easily produced in nature and more gas has been discovered in East Coast basins than oil. But Woodard disagrees. "We feel that this will be a good opportunity to find significant quantities of oil," he says.

—Kathy Hart



## A cross section

*Within the Carolina Trough, the Jurassic reef and diapirs (salt domes) seem most likely to hold oil. The trough formed as Africa and America split apart during the Triassic period. Deposits of sediment mounted on the rift stage crust, eventually burying the coral reef. (Adapted from map by Minerals Management Service)*



# Offshore oil wells: how close is too close?

In North Carolina, visions of oil tycoons wheeling and dealing to the clang of drilling rigs are just that. Visions.

So far the people with the most to say about oil have been the ones in government. For North Carolina, the focus has been on Gov. Jim Hunt and his Outer Continental Shelf (OCS) Task Force.

On the national level, Secretary of the Interior James Watt wants to speed up offshore oil development and to lessen the country's dependence on foreign oil—at the expense of the environment, say some of his critics.

Contrary to popular belief, Gov. Hunt is not opposed to offshore oil development. "The governor has always been supportive of efforts to develop new sources of oil and gas and to lessen the country's dependence on foreign sources," says Eric Vernon, coordinator of the state's OCS Task Force and chief policy analyst to the governor on OCS matters.

The United States imports 33 percent of its petroleum needs from foreign countries, many of them politically unstable, says Angela Waldorf, Associate Director for the N.C. Petroleum Council, a trade association for the industry. Proponents of offshore development point to the Arab oil embargo of late 1973 and

1974 and the 1978-1979 Iranian revolution to demonstrate the vulnerability of the nation to interruptions in the flow of imported oil.

Everyone agrees that the domestic production of oil needs to be increased. So, where's the controversy?

While the state has jurisdiction over the water, bottom lands and natural resources extending three miles offshore, the federal government controls the area seaward from three to 200 miles.

Still, what goes on in those waters could affect the state, its resources, its economy and its people—the things Gov. Hunt has pledged to protect.

Even with all the advice, much of what the task force bases its recommendations on is supposition. What if.

In the case of the first lease sale off North Carolina, the group reviewed the proposal and realized that six tracts lay between 12 and 16 miles east of Cape Lookout. What if a major oil spill occurred on one of those tracts?

That was a question that had already been addressed. In an environmental impact statement, the Department of Interior estimated that a major spill from the tracts near Cape Lookout had a 25 percent chance of reaching the beaches.

Thus began a chain of reactions. The

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*"The governor has always been supportive of efforts to develop new sources of oil and gas . . ." —Eric Vernon*

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Under the 1978 OCS Lands Act, the governor of an affected state has the authority to make recommendations to the Secretary of the Interior and to review planning and policy development at various steps along the way. Another safeguard, the Coastal Zone Management Act, requires that any federal activity be consistent with the affected state's laws and policies.

When Gov. Hunt decided to file suit against the Department of Interior over six environmentally risky tracts offered in Lease Sale 56, it wasn't a decision he reached on his own. Instead, he had the help of a task force, funded by the federal government through the Coastal Energy Impact Program and designed to look after the interests of North Carolina in outer continental shelf matters.

The 14-member group has representatives from Natural Resources and Community Development, the Department of Administration, Department of Cultural Resources, Department of Transportation, Department of Commerce and local government.

If the task force doesn't have the know-how to deal with a problem or question, they know whom to ask. They've built up a network of experts on OCS matters including researchers from the state's universities as well as from federal agencies such as the Minerals Management Service.

task force recommended that the governor recommend that the Department of Interior delete the six tracts from the proposed sale. When the Secretary of Interior rejected the state's request, it was the task force's turn to act again. They recommended that Gov. Hunt sue to prevent the offering of those six tracts. And he did just that.

Lease Sale 78, to be held this summer, will be the first to take place under Secretary Watt's new five-year plan. Former President Carter's Secretary of Interior, Cecil Andrus, identified areas of interest from the government's point of view and from the view of the private sector. Evaluations and geological studies of the tracts enabled the government to identify and offer the tracts of higher interest.

Now, under Secretary Watt's five-year plan, a much larger acreage is offered. There is little analysis prior to the sale. The Department of Interior identifies a broad area of interest and lets the industry select the tracts of most interest.

"I don't think there's any doubt about the changes to accelerate the process to offer as much acreage as possible and to get the government out of the business of identifying the interesting tracts," says Vernon. "The Department of Interior has taken a



Eric Vernon



very aggressive position on offering public lands for mineral extractions in general and this applies to the outer continental shelf."

Vernon cites reports that estimate 50 percent of the undiscovered petroleum resources of the United States are under the outer continental shelf. Yet only nine or 10 percent of the country's domestic oil comes from the outer continental shelf.

The five-year plan has gotten mixed reviews. Industries like it because they have more flexibility to decide on which tracts to bid. The Department of the Interior likes it because there are no lease evaluations prior to the sale. Secretary Watt says such evaluations are an inefficient use of resources because the department may be evaluating tracts that never get bids.

Opponents argue that the Department of the Interior is rushing into things, that they don't know about or care about the possible impacts to the environment.

Finally, the increase in the size of the offering makes it harder for state agencies to evaluate the potential problems of the offerings. For North Carolina, its offshore areas have been divided into the Mid-Atlantic and South Atlantic regions. This means that the task force's work could be doubled since they have to consider each lease sale separately.

Although the task force and the governor decided not to challenge Watt's five-year plan, Hunt did write a letter to Watt, encouraging him to abide by the federal-state partnership concept set by the OCS Lands Act and to listen to what the states have to say.

As for the citizens of North Carolina, Vernon has tried to assess sentiment on offshore oil in public hearings and meetings at the coast. "I think most of the people support the offshore program. I think they're very concerned that the outer continental shelf oil and gas industry be integrated into the current economic base—fishing and tourism.

"I don't think they want an industry that will come in there and upset the way they earn their living, but I think they understand the problem of developing a new source of energy and I think they support it so long as it does not threaten their quality of life or their economic base," says Vernon.

## Carolina crude—the story so far

*In June 1859, Edwin Drake used a wooden rig and a steam-operated drill to bore 70 feet into the Pennsylvania crust. In two months, Drake's well was producing 10 to 35 barrels of oil a day.*

Prospecting for oil off the coast of North Carolina is a longer tale—one that has been unfolding for about four years now. And still, oil companies have yet to drill the first exploratory well into the sediment of the state's outer continental shelf.

During those four years, the companies have been going through the motions—seismic surveys, exploratory plans, lease sales, permits to drill. On the government side are environmental impact statements, public hearings, task forces and a plethora of government agencies, each with its own concern in offshore oil development.

It takes only six months for the average exploratory well to be drilled, but it could take as long as two years from the time a company buys a lease to the time drilling begins. And that's only to find out what's down there. It's a wait-and-see game, say oil company spokesmen.

For North Carolina, the game began in 1979 when the federal government included tracts off the state's coast for auction to oil companies in August 1981. While most of the tracts for Lease Sale 56 were in a block about 100

miles off the coast between Cape Lookout and Wilmington, several tracts were off the northeastern coast of the state. Six tracts lay between 12 and 16 miles east of Cape Lookout.

In a 1980 environmental impact statement, the U.S. Bureau of Land Management estimated that a major spill, 1,000 barrels of oil or more, from the tracts near Cape Lookout would have a 25 percent chance of reaching the beaches.

Those odds seemed too high to Gov. Hunt who recommended to the Department of the Interior that the 54-square-mile area be deleted from the sale.

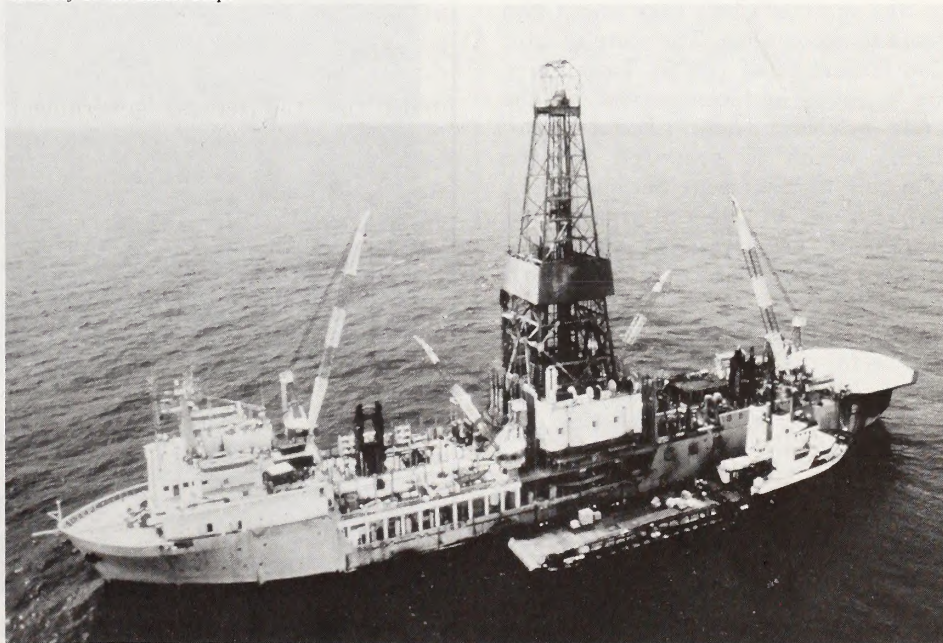
Although Secretary of Interior James Watt has the discretion to delete any tract from the proposed sale, he rejected North Carolina's request to remove the six tracts. Gov. Hunt responded by filing suit to stop the sale of oil-drilling rights in the six tracts.

Watt agreed to a compromise. If there were no bids on the tracts, North Carolina would drop the suit. If there were bids, the state reserved the right to go to court for an injunction to halt the drilling.

By the time the sale rolled around in August 1981, the oil companies weren't willing to involve themselves in any disputes between the federal and state

*Continued on next page*

*Courtesy of the Exxon Corp.*



—Nancy Davis

*Ships are used for test-drilling over deep-water sites*



governments. They chose not to bid on the six tracts near Cape Lookout.

Oil companies were awarded leases on 43 tracts off the coast of North Carolina. A Mobil Oil, Amerada Hess and Marathon Oil consortium bid \$103,775,000 for a tract off the northern coast of the state, where tracts received highest bids.

The threat of a lawsuit came up again in 1982 when Secretary Watt announced plans to include the six tracts near Cape Lookout in a re-offering of leases not bought in the first sale. The following month, amid talk of another lawsuit, Watt announced his decision not to offer drilling rights for those tracts nearest the North Carolina beaches.

Meanwhile, the oil companies were beginning the long, drawn-out process of permitting, and coastal residents waited for evidence that drill ships would one day probe beneath the ocean floor for oil.

Even before companies explored the possibilities of oil on tracts from Lease 56, the government began gearing up to offer more offshore leases. The proposed South Atlantic Sale 78, tentatively scheduled for July 1983, will be the first in this area to be conducted under the Department of Interior's new OCS process—the so-called five-year plan—designed to accelerate the discovery and development of offshore oil. The South Atlantic Region covers an area from North Carolina south to Florida.

The preparatory stages leading up to this summer's sale take about two years to accomplish. The state's Outer Continental Shelf (OCS) Task Force has received and commented on the draft environmental impact statement, which is prepared by the Minerals Management Service of the Department of the Interior. That statement assesses the effects of offshore oil drilling on everything from water quality to recreation and tourism. And it develops various alternatives for the proposed sale, including holding the sale as proposed, delaying or cancelling the sale or deleting certain blocks within the sale.

The OCS Task Force reviewed the document and recommended the governor support an alternative that deletes 151 tracts off the coast of North Carolina. That alternative would eliminate nearshore tracts that represent the greatest risk of oil spills reaching the shores and would delete

the block containing a portion of the USS Monitor National Marine Sanctuary.

According to the draft environmental impact statement, this alternative also ensures that offshore structures would not be visible from the Cape Hatteras National Seashore and reduces the chance of collisions in the heavily trafficked area.

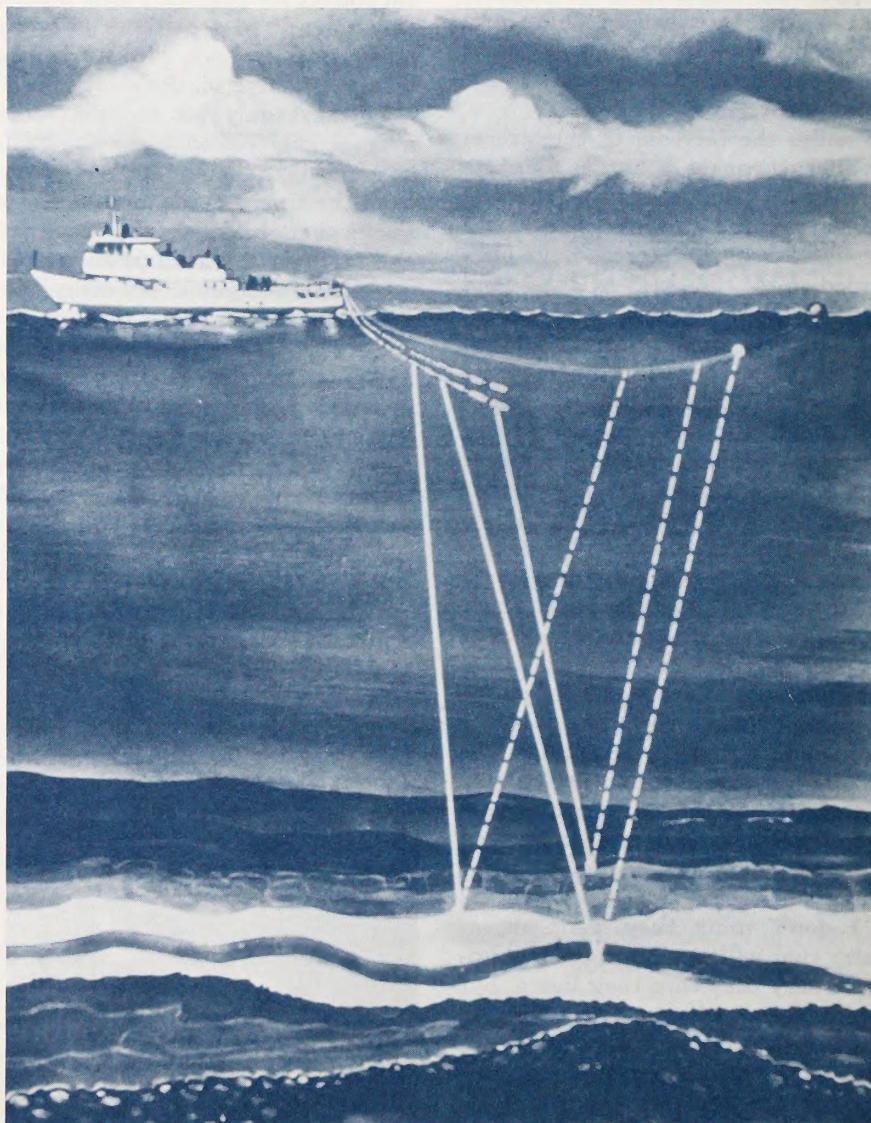
In a letter to Secretary Watt, Gov. Hunt outlined the state's position. The alternative would "eliminate the nearshore tracts which represent the greatest risk of oil spills reaching our shores and thereby protect our fishing and tourist industries," says Hunt in his letter.

By March, the final environmental

impact statement will be issued, reflecting the state's recommendations. At the same time, the Secretary of the Interior will make a proposed notice of sale.

Between the proposed notice of sale and the final notice of sale released in May, the state will establish its position with regard to Lease Sale 78. In Lease Sale 56, this was the stage in which Governor Hunt filed suit because North Carolina's recommendations were not heeded. If the governor feels the state's position has not been reflected, there's always the possibility of litigation and there could be a temporary injunction to actually stop the lease sale.

—Nancy Davis



*Searching for signs of oil, geologists use seismic ships to bounce impulses off strata below.*



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



What's in a name? Maybe more than you think. Gagfish, grunts and suckers go begging at grocery counters. An unsavory name can destroy the appeal of an otherwise tasty fish. And with no appeal in the grocery store, these fish bring only pennies a pound at the dock.

But there's one fish that's overcome its unsavory name: croaker. Sam Thomas, Sea Grant's seafood specialist at the NCSU Seafood Laboratory in Morehead City, says promotion put croaker alongside flounder and trout on grocery counters. "Once people realized it was a very acceptable fish to eat we started seeing demand for it," Thomas says. "When demand increased, the fishing effort increased and the fishermen started getting a better price for it."

Thomas says common fish names, usually bestowed by fishermen, reflect some action or habit of the fish (suckers) or perhaps their appearance (toadfish). Fish names may vary from fishing community to fishing community, and bear yet another name at the market. The U. S. Food and Drug Administration (FDA) controls market names. They want to assure consumers that what is being sold as perch is indeed perch.

Ridding a fish of its distasteful name is not easy. Fishermen and seafood dealers along the Pacific coast recently appealed to the FDA to change the market name of Pacific hake to Pacific whiting. The appeal worked. But it wouldn't be worth the time, effort and

expense to change every fish's name that was unpleasant.

Thomas suggests that a lesson be taken from croaker. Promotion and a little experimentation on the part of the consumer could improve the marketability of many unsavory-sounding fish.

The U.S. House of Representatives' Committee on Merchant Marine and Fisheries, chaired by N.C. Representative Walton Jones, will be studying the reauthorization of the National Sea Grant Program during February and March. The program was created by Congress under the National Sea Grant College Act and must periodically be reauthorized by Congress so it can continue to operate as a federal program.

During the study period, Congressmen and committee members would welcome public comment on the Sea Grant College Program.



Fishermen are once again invited to attend the North Carolina Commercial Fishing Show being held in Morehead City. The show, slated for March 12 and 13, will be held in the National Guard Armory at 3609 Bridges St. The in-water exhibits will be displayed behind the N.C. Division of Marine Fisheries building off U.S. 70 East, two blocks away. The show will run from 10 a.m. to 5 p.m. Saturday, March 12 and from 11 a.m. to 5 p.m., Sunday, March 13. Admission is free.

Dealers and manufacturers will be on hand to exhibit the latest in boats, engines, trailers, nets, traps, electronics and other commercial fishing gear. A series of mini-seminars will be offered by experts throughout the two-day event.

The North Carolina Commercial Fishing Show, the only boat and gear show in North Carolina designed especially for commercial fishermen, is sponsored by UNC Sea Grant in

cooperation with the N.C. Agricultural Extension Service, the N.C. Division of Marine Fisheries and the N.C. Fisheries Association. Last year's show attracted over 4,000 people. For more information about the show, contact Sea Grant agents Bob Hines and Larry Giardina at (919) 726-0125.



When it comes to taking it off, blue crabs know their business. The average blue crab will shed its shell 25 to 27 times during its life. And it's just after these sheddings, when blue crabs are soft, that they become a seafood delicacy—soft-shell crabs.

And for fishermen willing to cull out peelers (crabs preparing to shed) and hold them until shedding, the bonus can mean some added dollars in the bank. When prices are peaking, soft-shell crabs can bring over \$12 a dozen. And with a plentiful supply of crabs in North Carolina's brackish waters, more North Carolina fishermen are giving soft-shell and shedding a try.

That's why the UNC Sea Grant and Virginia Sea Grant Marine Advisory Services decided to cosponsor a workshop about soft-shell crabs. The workshop will be held March 5, at the Beaufort County Community College in Washington. The program, which is slated to run from 9 a.m. to 3:30 p.m., will feature panel discussions about crab biology, peeler identification, shedder harvesting methods, shedder facility design and marketing and economics. Discussions will include information on small backyard shedding trays and large closed shedding systems. Collington shedder Murray Bridges and Smyrna shedder Mark Hooper will be on several of the panels, along with UNC Sea Grant agents and specialists, Wayne Wescott, Bob Hines, Larry Giardina and Sam Thomas. Virginia Sea Grant specialist Mike Oesterling will also be a panel member.

*Continued on next page*



The fee for the workshop is \$5 in advance and \$6 at the door. For a complete agenda and a registration form, write Jim Murray, UNC Sea Grant, 105 1911 Building, North Carolina State University, Raleigh, N.C. 27650 or call (919) 737-2454.

But crabbing isn't just for commercial fishermen. Anyone can do it.

*Dipping and Picking: A Guide to Recreational Crabbing*, published by the South Carolina Sea Grant Program, describes and illustrates steps for catching (dipping), cooking and cleaning (picking) blue crabs.

For a free copy of this publication, write UNC Sea Grant, P.O. Box 5001, Raleigh, N.C. 27650-5001. Ask for *Dipping and Picking*.



Randy Rouse will replace Johnny Foster as manager and advisory agent at Sea Grant's Aquaculture Research and Demonstration Center in Aurora. Rouse,

who has been working at the center as a fisheries technician, will assume his new position Feb. 1. Ron Hodson, Sea Grant's associate director, will continue to act as director for the project.

Rouse received his undergraduate degree in wildlife biology from North Carolina State University. He has also worked for the N.C. Division of Marine Fisheries. Rouse will continue the biweekly aquaculture newspaper columns begun by Foster. He will also be working closely with Hodson to

construct the center's solar greenhouse.

Foster, who has been with the center for eight years, is leaving Sea Grant to open his own business.

The National Association of State Universities and Land-Grant Colleges (NASULGC) has created a marine division to go along with its agriculture and urban affairs divisions. The marine division will enable member universities to more effectively address national issues pertaining to marine problems.

UNC Sea Grant Director B. J. Copeland will serve on the membership committee within the division. North Carolina State University Chancellor Bruce Poulton will serve on the legislative committee and Dirk Frankenberg, director of the Marine Science Program at the University of North Carolina at Chapel Hill and UNC Sea Grant's coordinator for coastal studies, will serve on the budget committee.

Mini-grant funds have been awarded to John Maiolo, an East Carolina University sociologist, to study the impact of a proposed shortening of the season for harvesting menhaden. Overfishing is a growing problem in the menhaden fishery, and the Atlantic States Marine Fisheries Commission is considering shortening the season as a possible solution. Maiolo will be studying how the shortened season might affect employment, revenues to the menhaden fishing industry and regional economics.



For four days during March, North Carolina's outdoors will be on display indoors at the Raleigh Civic Center. The 1983 Outdoors North Carolina Expo will be held Thursday, March 24 through Sunday, March 27.

The N.C. Marine Resources Centers will have an exhibit entitled, "More than fish in the sea." There, you will be greeted by a giant Portuguese man-of-war mobile. You will be able to touch a sea urchin, starfish or clam and view sea turtles and octopuses in the aquariums. And, if you want to learn more about the shells found along our beaches, there will also be a shell display and shell-identification game.

The expo is sponsored by the N.C. Department of Natural Resources and Community Development along with the Raleigh Civic Center, state and federal agencies, citizens groups and the outdoors-recreation industry.

*Coastwatch* is published monthly except July and December by the University of North Carolina Sea Grant College Program, 105 1911 Building, North Carolina State University, Raleigh, NC 27650-5001. Vol. 10, No. 2, February, 1983. Dr. B.J. Copeland, director. Neil Caudle, editor. Kathy Hart and Nancy Davis, staff writers. Second-class postage paid at Raleigh, NC 27611.

## COASTWATCH

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# COAST WATCH

Courtesy of the Exxon Corp.



*Oil-drilling platforms off Louisiana, in the Gulf of Mexico*

## Offshore oil: what's in it for North Carolina?

When oil companies finally plunge their drills into North Carolina's outer continental shelf, chances are that folks on the beaches won't even know the drilling is going on.

But that hasn't stopped them from asking questions. They want to know what an oil find would mean for the state. Will there be economic benefits? Will the drilling mean more jobs? Will it pose a harm to the environment? In

short, they want to know, what will be the costs and benefits of offshore oil drilling for North Carolina?

The fact is that no one knows for sure what it'll mean for the state. We can't look to other states for answers because what's happened with offshore oil drilling there doesn't always apply in North Carolina. The water is much deeper off our coast and the currents much stronger.

And then there are those who point out that any discussion of these questions is premature. After all, there may not even be any oil out there.

What we do know is that for now, while companies are still in the exploration stage, there probably won't be any boom towns on the state's coast. Eric Vernon, coordinator of the state's Outer Continental Shelf Task

*Continued on next page*



Force, says there are no plans for any major onshore facilities such as a refinery. And even if oil companies go all the way to production of oil, the direct benefits to North Carolina would be minimal.

But he doesn't exclude the possibility of North Carolina gaining from the oil exploration since any offshore oil operation has to have an onshore support base. (Morehead City has been chosen as the site for a support base.)

As development offshore increases, says Vernon, onshore activity will increase and that will generate some revenues in the state.

Angela Waldorf, associate director of the N.C. Petroleum Council, says local merchants will benefit when the oil companies contract for services for employees on the drill ship.

Chevron, the company first in line to begin drilling, estimates it will be buying food for three meals a day for a crew of 100 as well as supplies to maintain the drill ship.

But as for local residents looking to land a job on an oil rig, Waldorf says that probably won't happen because the state's work force isn't technically trained for oil drilling.

Most of the workers will be from out-of-state. They'll work on a rig for two weeks, then take a helicopter to the airport and fly home.

The federal government stands to gain considerably from offshore oil exploration, whether oil is discovered or not. In 1981, total receipts from

bonuses, rents, rights of way, royalties and interest on leases put \$12 billion into the federal treasury.

Some of that money comes back to the state in the form of the Coastal Energy Impact Program (CEIP), but at this point, there are no direct funds coming to the state as a result of offshore oil leases.

will have "several unavoidable, adverse environmental effects," all of which will be "temporary, localized and reversible."

According to the report, air quality will be affected by emissions from the ship during drilling, but breezes will quickly disperse the fumes. Water quality will be affected by releases of

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*We can't look to other states for answers because what's happened with offshore oil drilling there doesn't always apply in North Carolina.*

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This could change if a bill passes in this session of Congress requiring sharing of revenue from offshore oil and gas exploration. The legislation would give North Carolina and other coastal states a share from the sale of offshore drilling leases. The bill's sponsor, Rep. Walter Jones, D-N.C., estimates North Carolina would gain \$9.3 million from leases during the 1984 budget year. House hearings on the revenue-sharing bill were scheduled for March 1 and March 10.

On the cost side, there's only speculation. Could we be harming our environment with offshore oil development?

The most obvious concern is an oil spill. (See story on next page)

But there's more to it than that. In a report submitted to the state's Outer Continental Shelf (OCS) Task Force, Chevron says the exploratory drilling

drill cuttings and of muds used as a drilling lubricant.

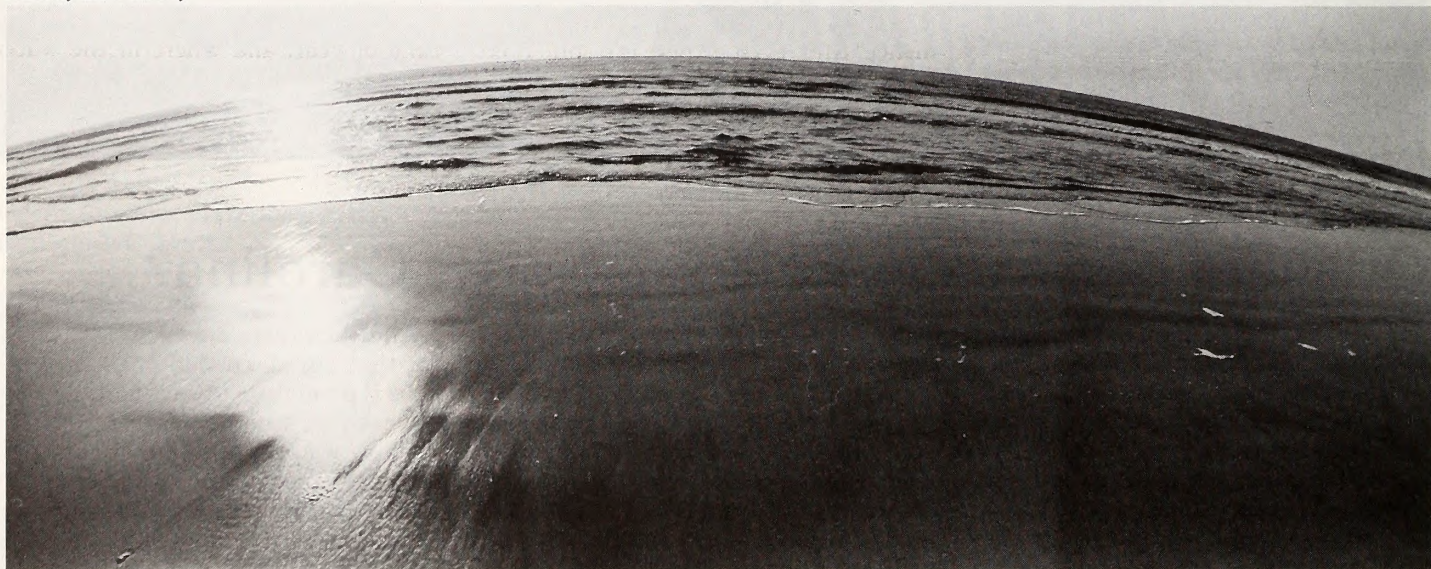
The rock cuttings are discharged continuously with little effect. There is concern, however, over the muds.

Made of clay minerals, some minor components of some drilling muds have been found to be toxic in the laboratory, says Bill Kirby-Smith, an associate research professor at Duke University Marine Lab in Beaufort. But he adds that, in field situations, the toxicity is much reduced by dilution of the muds as they are dispersed in the water.

In areas of strong currents, the finely textured muds remain in the water column until they're carried away from the drilling site and dispersed in a wide area. In weaker currents, the majority settles to the bottom, says Kirby-Smith.

That causes more concern. National

Photo by Steve Murray



*The view offshore, distorted by a wide-angle lens: Oil companies say that because of Earth's curvature, offshore wells would be hidden from North Carolina beaches*



Marine Fisheries Service fishery biologist Gene Huntsman says the cuttings and muds could bury reefs in the area of drilling—reefs that support substantial fisheries off North Carolina.

To protect those reefs, oil companies must comply with the biological stipulations attached to offshore leases, says Guido De Horatiis of the Minerals Management Service. As part of its pre-drilling permit process, a company must conduct geophysical surveys to determine if the drilling site is a hard bottom area. Since living things such as sponges and corals often attach to such hard bottoms, thereby attracting a community of fish, the companies must prove the discharge of materials from the drilling will not affect the area.

Chevron's report points out that companies have been drilling in the Gulf of Mexico for over 20 years without any significant effects from mud discharges, even in the shallower waters.

If oil companies do find oil and go into production, there's the problem of how to get the oil to shore. Yates Sorrell, a North Carolina State University Mechanical and Aerospace Engineering professor, looked into the problems of pipelines from offshore wells to onshore.

Sorrell says it's important to place the amount of potential impact in perspective. "Shrimp trawling in North Carolina's inside waters annually disturbs a far greater volume of sediment than would be disturbed by a number of major pipelines."

Sorrell says most of the problems associated with pipelines can be alleviated with careful planning.

There's always the possibility that oil companies won't find commercial quantities of oil. Even if they don't, Vernon says nothing will be lost. He recalls a previous sale off the coast of Georgia. "Everything was geared up, everybody was ready to go and they just didn't find anything. They drilled six holes and they were all dry and they abandoned their efforts," he says.

He adds that the process took three years once the lease sale had been conducted. Vernon predicts North Carolina may be in for a similar wait before we know for sure what will be the impacts of offshore oil drilling in this state.

—Nancy Davis

Photo by Hilda Livingstone



*Bags of oily sand during cleanup in Dare County, after a 1980 spill.*

## Spills—the trouble with oil

Oil spill. The words are so married by consonance as to make the event they describe seem practically inevitable. Where you have oil, you'll have spills—right?

Not according to the petroleum industry. In public meetings up and down the coast, oil company spokesmen have been assuring North Carolinians that we will probably never see oil spilled from a rig offshore. The gist of their argument is: First of all, it is highly unlikely that oil will turn up in quantities sufficient to attract much drilling off North Carolina. It is even more unlikely that any oil would spill, should the drilling commence. And, even if there is a spill, it is unlikely to approach the coast. And, even if it did, cleanup teams would mop it up before it came ashore.

So with unlikelihood piled upon unlikelihood, the companies argue, risks of a destructive oil spill reaching our beaches or marshes from drilling offshore are "extremely remote."

But are they? Research has not entirely settled the questions about oil spills, but studies do help show some of the factors involved—the speeds and directions of currents, the sensitivity of marshes and beaches to oil damage, the so-called "fate" of oil in the environment.

Len Pietrafesa, an oceanographer at North Carolina State University, has conducted a set of research projects,

funded by Sea Grant and others, in which he studied the paths of currents off North Carolina, recording data on winds, sea level, temperature and salinity. In a research supported by the Bureau of Land Management, he compiled such information for the outer continental shelf from Cape Hatteras to Cape Canaveral. Pietrafesa's reports have drawn no conclusions about the oil-drilling process, but his work has been cited by state officials concerned about leasing tracts nearest the coast.

Pietrafesa says that the chance of a spill reaching shore depends upon where offshore the spill occurs, the time of year, and where in the water column the oil is released. "For instance, if you were to have a spill from, say, September through February, if the spill were near Cape Lookout and at the surface, there would be a ninety-five percent chance of oil reaching the beach," he says, as long as the spill is within twenty miles of the coast. "In other areas, say twenty miles off Cape Hatteras during April, oil would have a twenty percent chance of reaching the beach."

Pietrafesa says that if a spill occurred in the Gulf Stream, it wouldn't necessarily flow north and miss the state. Every week and a half or so, waves from the Gulf Stream (called Gulf Stream frontal events) push a

*Continued on next page*



load of sediment, nutrients and larvae into coastal ecosystems. Such waves, Pietrafesa says, might also carry oil.

Using sophisticated wave and current-monitoring gear, Pietrafesa has accumulated a collection of data that he says will help scientists predict the path of an oil spill, should one occur. Such information is vital, since the high-energy waves, winds and currents off North Carolina would pose unique problems during a spill.

"Our coastline is clearly more energetic than anyplace else on either the Atlantic or Pacific coasts," Pietrafesa says.

And though the oil companies say their engineers can design drilling rigs to withstand such forces, they are taking a hard look at the high currents and deep waters. Wally Worthington, offshore district drilling engineer for Arco Oil and Gas Company, a division of Atlantic Richfield, says that his company's leases are in water 1500 to 2000 ft. deep. When Arco begins its test-drilling, perhaps sometime in 1984, it will use drill ships and the cost will run about \$100,000 a day.

"We have drilled in waters fifty-eight hundred feet deep in the Mediterranean," Worthington says, "The technology isn't new; it's just unproven, particularly in a high-current area. We have drilled in high currents but not in deep water with high currents. That's why we check, double-check and triple-check our planning."

To help protect themselves from liability in the event of an oil spill, companies have allied to hire a single contractor to look after their oil-spill cleanup operations in the Atlantic. The contractor, Haliburton Services, says it will set up shop in Morehead City sometime before drilling begins, and will keep gear, such as floating oil-containment booms, ready to go. The firm estimates that it could have a team on the site of a spill two hours after it occurs.

But as is the case with drilling rigs, the techniques for containing oil are untested in conditions like those off North Carolina. And, while the booms perform well in the calm waters of the Gulf of Mexico, they are not designed for seas greater than eight or 10 feet.

And what if oil does spill, does evade the cleanup, and then makes its way to shore? The familiar pictures of oily shorebirds and blackened beaches con-

vey the ugliness of an oil spill, but not much about its effects on the environment. Most scientists agree that the effects of an oil spill on beaches seem to be moderate and reversible. Studies of coastal oil spills have for the most part shown that, although some marine organisms die off immediately following a spill, their populations are reduced by no more than occurs during seasonal variation. The most toxic parts of an oil spill—the aromatic compounds—evaporate soon after a spill, so that often only the heavier, less deadly "tars" reach shore.

Photo by Hilda Livingstone



*Tar-like remains of oil slick*

For three weeks in 1970, an estimated 65,000 barrels of crude oil were discharged from a Chevron oil-production platform 11 miles east of the Mississippi River Delta, in the Gulf of Mexico. Researchers estimated that between 25 and 30 percent of the oil evaporated during the first 24 hours. Ten to 20 percent was cleaned from the surface of the water. Less than one percent dissolved, and less than one percent turned up in sediments within a five-mile radius of the platform. The remaining oil emulsified and dispersed to undetectable levels, biodegraded or photo-oxidized.

Oddly enough, few regions of the country have had more experience with spilled oil than the Outer Banks of North Carolina. During the first six months of 1942, German U-Boats sunk 100 merchant ships off the East Coast, spilling about 484,200 metric tons of petroleum products into American coastal waters. Nearly one-quarter of this petroleum was concentrated in the

waters surrounding Cape Hatteras.

In a report published in 1977 by Sea Grant at the Massachusetts Institute of Technology, researchers concluded that fourteen slicks totalling about 161,500 barrels of fuel oil were released near Ocracoke Island during 1942. Three of the slicks reached shore. Residents elsewhere on the Outer Banks remember oil on the beaches almost constantly during the period. The report states that although there are no data available on the impact of fisheries and wildlife, residents and newspaper reports claimed that fishing and duck-hunting "were as good as ever."

The scientists also found that the Outer Banks acted as a natural barrier to drifting oil, protecting the more sensitive and productive inland waters of Pamlico Sound.

The report concludes: "It would be desirable to draw from these results the conclusion that nature would recover its losses in all cases given the required amount of time. Although this may be true, the results of this study will not prove this assertion. It can, however, be said that in two cases, regional wildlife and economy survived with minimal difficulty."

In fact, the most serious damage to North Carolina beaches from a modern oil spill might be economic: tarred beaches put a damper on tourism and slicks can temporarily disrupt fishing and boating. But if oil did make its way into marshes and estuaries, the stakes would be much higher.

Scientists say that much more study is needed before they can be sure of the effects of oil spills on marshes and estuaries. In some areas, the damage has been dramatic. After the Amoco Cadiz spill in 1979, miles of invaluable marsh and wildlife habitat along the Brittany Coast of France were destroyed. (Researchers Ernie Seneca and Steve Broome of North Carolina State University have been helping the French re-establish new marsh with planting techniques they developed during a UNC Sea Grant project.)

And even when the results are less obvious, oil causes subtle changes in marsh ecosystems. Frederick Phaender, a scientist from the University of North Carolina at Chapel Hill, has studied the effects of petroleum on marsh grasses in experiments near Morehead City. Phaender and a student, Earl Buckley, used a synthetic



crude oil in their test plots. They found that oil inhibits cellulose mineralization, the natural breakdown of plants in the marsh.

"The bacteria, instead of using the marsh grass, switched over and used oil," Phaender says. And while the diet of oil did not seem to harm the bacteria, Phaender says more study will be necessary to show missing links in oil's progress up the food chain.

"One thing we don't know," Phaender says, "is what happens if the zooplankton, which feed on the bacteria, don't like the taste of oil."

After a spill May fifth of last year from a tanker in the Cape Fear River, the U. S. Coast Guard spent \$100,000 to clean up heavy fuel oil, but did not

have the means to clean nearby marshes as well. And although the effects of the spill seem to be gone, state officials want to study the site, not only to evaluate the damage, but to help predict the effects of other spills.

Such spills from tankers bringing oil into North Carolina may indeed already pose a greater threat than offshore drilling platforms ever will. A draft environmental impact statement published by the U. S. Department of Interior concludes that "spills resulting from existing leases in the region are projected to number approximately one. The greatest number of spills is associated with the transportation of hydrocarbon products. Thus, should the proposed

sale be cancelled, the risk of oil spill occurrence would still exist due to the present volume of oil being imported through the region."

Even so, North Carolina officials want to play it safe, assume the worst, and discourage drilling on tracts nearest shore. According to Eric Vernon, chairman of the state's Outer Continental Shelf Task Force: "The outer continental shelf offshore oil industry has an excellent safety record, so that helps. But there will be spills—there's no question about that—as long as the activity goes on. We just hope that by proper planning and the use of the best kind of technology, that those spills can be minimized."

—Neil Caudle

## If, when, maybe And then again

Chevron USA may begin drilling North Carolina's first offshore exploratory well for oil and gas this year. Then again they may not. Chevron may bring in a large sophisticated drill ship to do actual drilling. Then again they may not.

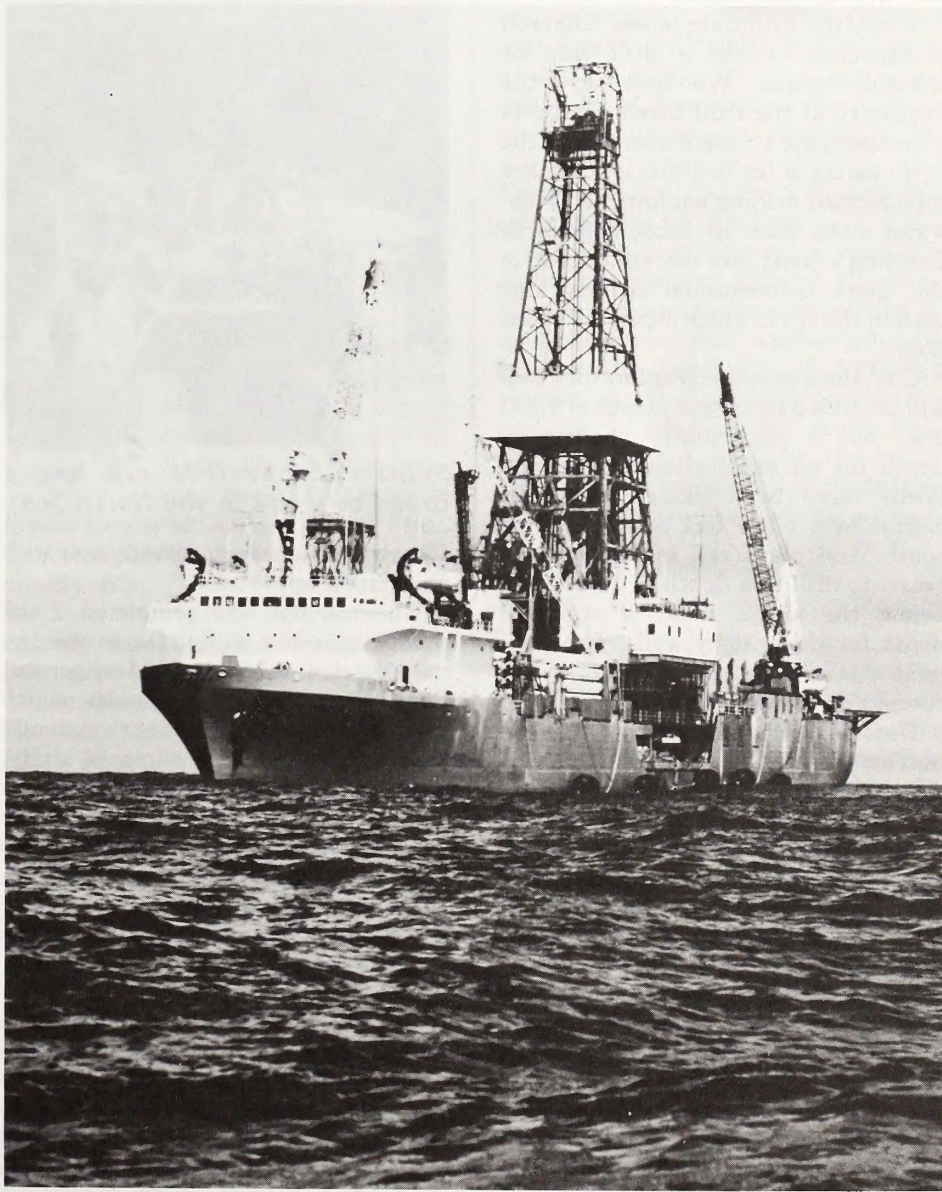
Sound a little uncertain? It is. Until the drilling actually begins, plenty of avenues are open for change. And North Carolina's outer continental shelf offers the oil companies a few extra challenges—deep water, a strong Gulf Stream current—that require added precautions, money, expertise and time for planning.

State and federal officials predict Chevron USA should be the first oil company to emerge from the maze of permits, plan-approvals and bargaining needed to assemble an exploratory well. Chevron would like to begin drilling on Manteo Block 510 in tract 18, 38 nautical miles east-northeast of Cape Hatteras, during 1983, says R.L. Woodard, Chevron's division exploration manager for the northern division. But the schedule is far from set.

Chevron is negotiating with companies to finance the well, and no agreement can be reached on a drilling date, Woodard says. Chevron purchased Block 510 with Conoco Inc. and Shell Oil Co., in Lease Sale 56, paying over \$26 million. Other com-

*Continued on next page*

*Courtesy of Phillips Petroleum Co.*



*Drill ships: one of the maybe/maybe not*



panies with nearby blocks, such as Mobil, Amerada Hess and Marathon, are expected to share in the well's estimated \$20 million price tag and in the geologic information gleaned from exploration. But falling worldwide oil prices have left oil companies hesitant to gamble on exploration, Woodard says. "Our partners say, let's wait and see how things go," Woodard says. "But we (Chevron) would like to go ahead and drill this year."

Chevron had planned to drill with the *Sedco 472*, a top-of-the-line drill ship designed especially for deep-water exploration. But with the drill date being uncertain, those plans were cancelled, Woodard says. Chevron contracts with drilling companies to do exploratory work and the final choice of vessel depends on availability when the drilling time comes.

When the drill date is set, Chevron is expected to use a drill ship or semisubmersible. Woodard says the proximity of the Gulf Stream with its accompanying strong currents and the deep waters of the drill site will require sophisticated drilling equipment. Deep-water sites, such as those off North Carolina's coast, are not conducive to the more conventional drilling rigs used in the Gulf, which sit on the ocean floor.

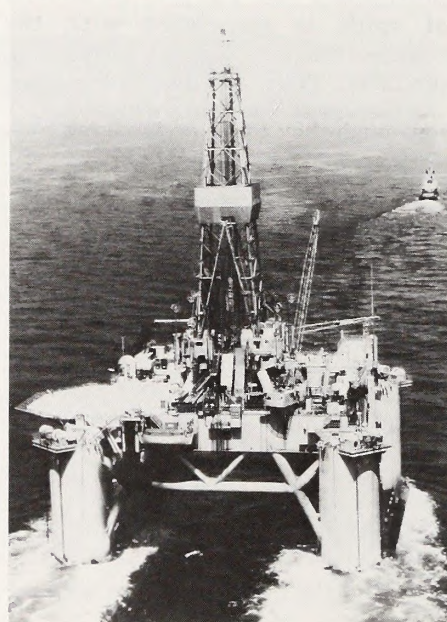
Chevron's proposed exploratory well will be drilled in a water depth of 2,132 feet, not a particularly challenging depth for oil exploration technology. Wells have been drilled in water depths over 6,000 feet off the French coast. And plans call for the drilling vessel to drill to a depth of 20,000 feet below the ocean floor, a standard depth for exploratory wells. The company estimates it will take 144 days to complete the exploration.

But before the first drill bit can burrow into the ocean floor, Chevron must obtain permits and plan-approvals that meet with state and federal regulations. Chevron has already received an Army Corps of Engineers permit that ensures the placement of a drill ship does not interfere with navigation or national security, and an Environmental Protection Agency discharge permit allowing effluent discharges into surrounding waters.

Chevron must also file an exploration plan and environmental report with the state. The Outer Continental Shelf Task Force reviews the plans to

see if they are consistent with the state's coastal management plan. Both the governor and the state Office of Coastal Zone Management comment on the plans based on the task force review, says Eric Vernon, coordinator of the task force. The governor makes his comments to the U.S. Dept. of Interior's Minerals Management Service, while the Office of Coastal Zone Management makes its comments to the U.S. Dept. of Commerce's National Oceanic and Atmospheric Administration, Vernon says.

*Courtesy of Texaco Inc.*



*Semi-submersible rig being towed to a site in the North Sea*

Chevron's plans have already met with the state's approval.

Chevron has also completed a six-month currents study. On a case-by-case basis, the Minerals Management Service is asking oil companies, which plan to drill along the South Atlantic coast, to complete a currents study, says Guido De Horatiis, team leader for the Mid-Atlantic District of the Minerals Management Service. The proximity of the Gulf Stream along with surrounding deep waters meant some extra engineering precautions might be needed, says De Horatiis.

The final step Chevron must complete before drilling is approval of a permit to drill from the Minerals Management Service. To satisfy one of the requirements for the permit to drill, Chevron must have an oil spill contingency plan that meets with U.S. Coast Guard approval. Chevron must

prove to the Coast Guard that it has the capability, both mechanically and with trained personnel, to deploy its oil spill cleanup equipment quickly and efficiently. Chevron's oil contingency plan has not yet been approved, says De Horatiis.

Federal standards also require Chevron to perform an oil spill drill that will demonstrate their oil spill cleanup capabilities. De Horatiis says Chevron plans to complete its demonstration at the drill site during some preliminary work.

The Minerals Management Service is requesting some additional information from Chevron before it makes its final review of their permit-to-drill request in early March, De Horatiis says.

When all its permits are in a row, Chevron need only choose a drill date and drilling vessel before setting up shop along the state's outer continental shelf. And except for occasional helicopters whirling overhead, coastal residents and visitors will never know Chevron is drilling, Woodard says. The curvature of the earth will prevent beachgoers from seeing the drilling vessel, and Woodard says that no oil or gas burn-offs will cloud the sky.

And Chevron isn't the only oil company preparing to drill. Arco Oil and Gas Co., a subsidiary of Atlantic Richfield Company, has begun the permitting process for drilling on Block 709 or 710 in Tract 28, which it bought along with Murphy Oil Corp. and Odeco Oil and Gas Co. for over \$2 million. Their exploration plan and environmental report has already met with state approval, Vernon says. Their plans call for using the *Aleutian Key*, another drill ship, for exploration.

But they lack some necessary federal permits. "They have not applied for their permit to drill and are still working on their currents study," De Horatiis says.

Wally Worthington, offshore district drilling engineer for Arco, says it will be 1984 before Arco begins drilling off North Carolina "unless Chevron gets started and makes a discovery."

But nothing is certain when it comes to oil companies, drill ships and schedules, says a spokesman in the oil industry. "What we say today could be different tomorrow," she says. "Things are always changing."

—Kathy Hart



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919)/737-2454).*



In North Carolina, the charter boat season generally lasts from Easter weekend to Thanksgiving. But some boat owners have been booking groups since last

fall. And most boats are already reserved for the more popular spring and summer weekends.

Jim Luxton at the Harker's Island Fishing Center says North Carolina has three traditional types of charter boat fishing. For the strong stomachs, there's fishing on the Gulf Stream. You could look forward to catching tuna, wahoo, dolphin and billfish. That's about a 12-hour trip with an average cost of \$500.

Charter boats also make in-shore fishing trips that last nine to 10 hours and average \$400 in cost. Your catch might include king mackerel or bluefish.

If it's bass, grouper or snapper that you're after, you need to go bottom fishing, says Luxton. That's about a \$350 trip.

While those prices are averages for North Carolina boats, Luxton says they usually include the boat for the day, the crew, bait, tackle and ice. He adds that most charter boat captains are willing to tailor the trip for the customer.

Most charter boats hold about six passengers. If you're looking for a less expensive fishing day, you might consider a head boat. They hold 25 to 75 people and cost \$40-\$45.

Luxton advises making reservations for a charter boat four weeks in advance.

Larry Giardina and Sam Thomas, of Sea Grant's Marine Advisory Services, will be displaying packaged and frozen seafood at the Carolina Food Service Expo, sponsored by the N.C. Restaurant Association, March 22-24 at the Charlotte Merchandise Mart.

They'll be answering questions from restaurateurs and food service operators—when the seafoods are in season, where they can be bought and how much they cost—and making contact with buyers. Giardina says he'll report back to seafood dealers in North Carolina so they can follow up on his leads.

The booth, "Seafood USA," is sponsored by the Gulf and South Atlantic Fisheries Development Foundation. For more information, contact Larry Giardina at (919) 726-0125.



John Sanders, Sea Grant's marine weather awareness specialist, has been spending a lot of time before the cameras lately. He has been helping the Educational

Media Center at North Carolina State University (NCSU) put together a 20-minute film, "Before the Hurricane Strikes," warning people of the hazards of hurricanes and telling them how to prepare for powerful storms.

The film features old footage from Hurricane Hazel, new footage from Kitty Hawk, where 12 cottages were undermined by an October 1982 northeaster, and time-lapse satellite photography of the tropical areas where hurricanes are spawned. The film will also feature Pamlico Junior High School students going through the steps needed to prepare for a hurricane.

While the film is visually tailored for North Carolina audiences, it can be used in other Atlantic and Gulf states, Sanders says. "The script was written in such a way that the information can be used in any state threatened by hurricanes," says Sanders.

The film is part of a package, which

includes an instructional guide, that will be distributed by the Educational Media Center. The package will be available to schools, museums and other interested groups for a minimal charge. For information about the film, write Jeannie Seamon, Educational Media Center, 2318 D.H. Hill Library, NCSU, Raleigh, N.C. 27607 or call (919) 737-3971.

Luis Aguilar Valdez, a University of Mexico professor of animal ecology and aquaculture, will spend the next four months in Raleigh learning more about American methods of aquaculture. Ron Hodson, Sea Grant's associate director and director of the Aquaculture Research and Demonstration Center in Aurora, will serve as host for Aguilar.

Aguilar is participating in the Latin American Visiting Scholar Program. He will be learning more about tilapia, an African food fish. Aguilar wants to explore the feasibility of fertilizing culture waters with swine and poultry manure to increase blue-green algae growth. Tilapia feed on the algae. Hodson, who has also been conducting some tilapia studies, will be advising Aguilar.



Leon Abbas, UNC Sea Grant's marine recreation specialist, has been recognized by the N.C. Marina Association for "providing educational opportunities" to the state's marina industry.

Abbas received a plaque during the association's annual meeting, held Jan. 21 and 22 at Wrightsville Beach. Jerry Macon, past-president of the association, said that Abbas has "helped us with our projects, and with our communications with state agencies."

Abbas received a similar award two years ago, when the association honored him for providing information the group needed to organize its programs.

*Continued on next page*





UNC Sea Grant has published two Blueprints written by Sea Grant specialists, Sam Thomas and John Sanders. "Fire Prevention Safety Tips," written by Thomas, a seafood specialist at the NCSU Seafood Laboratory in Morehead City, is designed to help seafood processors and food processors protect their processing plants from fire. For a free copy, write UNC Sea Grant, P.O. Box 5001, Raleigh, N.C. 27650. Ask for publication, UNC-SG-BP-82-2.

"Hurricane Safety Checklist," written by Sanders, Sea Grant's marine weather awareness specialist, provides step-by-step instructions for helping coastal residents prepare for an approaching hurricane. For a free copy, write UNC Sea Grant. Ask for publication, UNC-SG-BP-82-3.



When it comes summer, you can bet Lundie Spence has a calendar full of coastal workshops planned for teachers. And this year, Spence has three workshops on tap.

The first is set for the Teacher Institute in Belize, a small country south of Mexico. The ten-day workshop (July 7 to July 16) is designed for upper elementary and secondary science teachers. Participants will investigate rivers, mangrove swamps, grass flats

and coral reefs. In addition to science activities, teachers will visit Mayan ruins and canoe old Mayan trails. The Institute is designed to teach field science techniques, to provide teachers with an opportunity to work with scientists doing research and to help teachers make comparisons between North Carolina ecosystems and tropical ecosystems. The workshops will be limited to 15 teachers. It will cost approximately \$900. Teachers will receive certification renewal units and Gifted and Talented credit. The workshop will be sponsored by N.C. Dept. of Public Instruction's Division of Science Education and UNC Sea Grant. For more information or an application, write Lundie Spence, UNC Sea Grant, 105 1911 Building, North Carolina State University, Raleigh, N.C. 27650 or call (919) 737-2454.

The second summer workshop, "Coastal Beginnings—America's 400th Anniversary Celebration," is scheduled for July 17-24 at the N.C. Marine Resources Center on Roanoke Island. This workshop will focus on the nation's first colony—its culture and its environment. The workshop is limited to educators who teach North Carolina history. Spence is requesting that teachers apply in teams of three (one fourth grade teacher, one eighth grade teacher and one supervisor or administrative resource educator) from each of the eight educational regions. The workshop will cost approximately \$120 and is sponsored by Sea Grant, the 400th Anniversary Committee, the N.C. Marine Resources Center at Roanoke Island

and the N.C. Dept. of Public Instruction's Division of Social Studies. Participating educators will receive renewal units and Gifted and Talented credit. Write Spence for an application.

The final workshop, "The Sea and Science," will be held July 24-29 at the Cape Fear Technical Institute in Wilmington. Teachers will learn about the chemistry, biology and geology of the ocean and about beach and salt marsh communities. The workshop is limited to 25 educators—science teachers (grades 7-12), marine occupations teachers and career exploration teachers. The cost is approximately \$120. Educators can earn renewal units and Gifted and Talented credit. The workshop is sponsored by Sea Grant, the Cape Fear Technical Institute and the N.C. Marine Resources Center at Ft. Fisher. Write Spence for an application.

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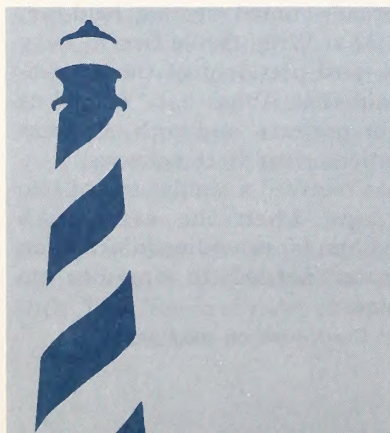
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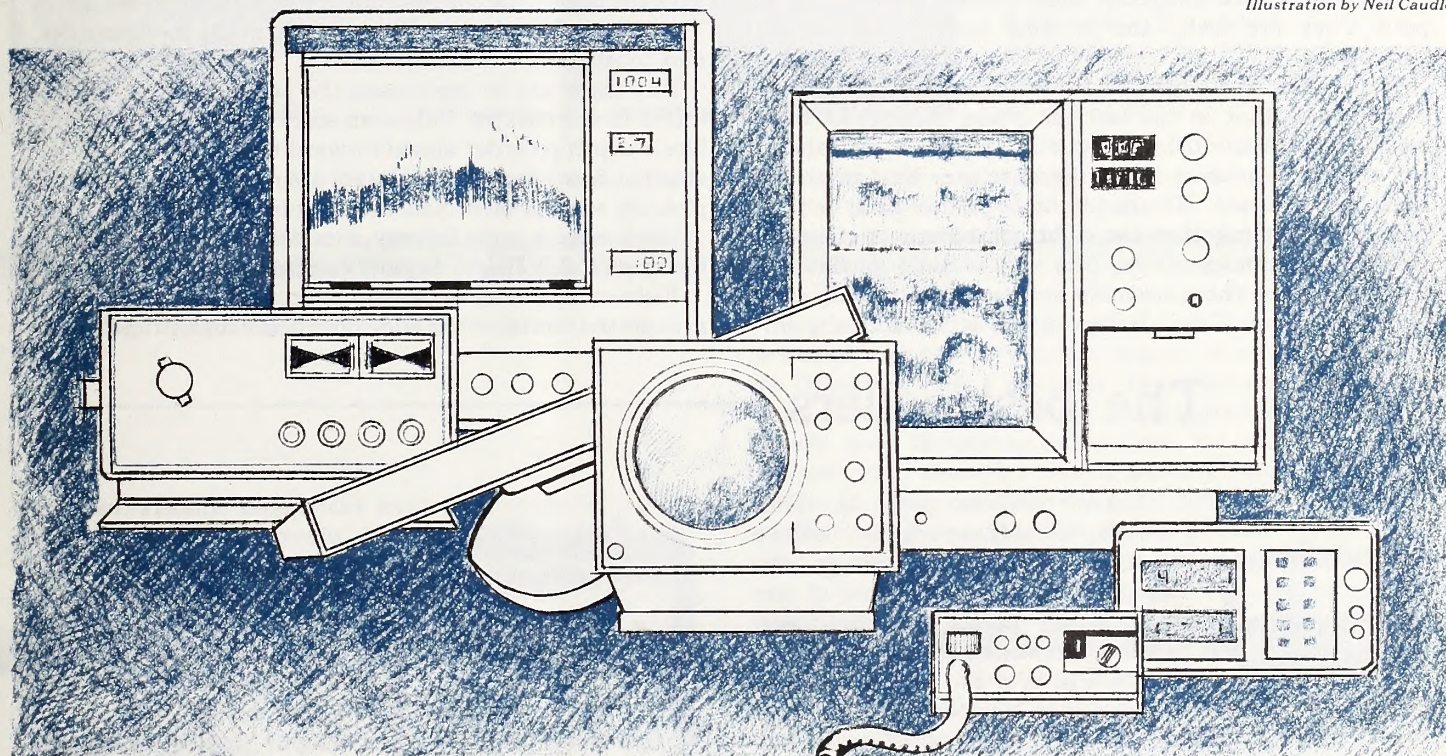
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# COASTWATCH

Illustration by Neil Caudle



## Gadgets that changed fishing forever

Today's captain may spend more time peering into video screens and printouts than he does peering into water.

Fishermen today won't leave the dock without their solid-state circuits, their transducers, their computer chips. They listen for fish with electronic ears. They sail to sea and home again on the pulse of a radio wave.

The value of North Carolina's seafood catch has doubled in the past five years, to a single-year record of \$60 million for the dockside value. Many fishermen will tell you they would never have landed that much seafood without the new generation of electronics.

Others will argue that new gear has made our fleet so efficient, so adept at raking in the catch, that we're fishing ourselves out of business. The new gear is so

easy to use, men can jump competitive more quickly than ever before.

"It (electronic gear) probably does have some effect, because it increases efficiency," says Mike Street, of the N. C. Division of Marine Fisheries. "Whether that is a significant factor in putting pressure on stocks, I don't know."

And, it's not only the commercial fleet that's laying out hard cash at the electronics store. Sportsfishermen by the thousands are wiring their boats and comparing wattages.

This month, *Coastwatch* looks at marine electronics—who needs them, how they work, and what we did before we had them.



# Electronics: what you'll plank down to plug in

To the uninitiated, a first visit to the marine electronics store is like walking into the nest of some newly hatched species of gizmo. The things are so animated, you can almost imagine one perched on the shoulder of an old skipper, blinking its digital eyes and chattering away in the latest "user-friendly" computer-speak.

But for all their gadgetry, these critters are not toys or pets. They are tools—the working tools of the serious fisherman.

Jim Bahen, Sea Grant's marine advisory agent at Fort Fisher, says that in the last ten years, electronics have revolutionized the fishing industry. It's part of Bahen's job to help fishermen choose and use gear that improves their performance. He spends much of his time helping fishermen put together the right combinations of boats, rigs and electronics.

"These days, there are more and more boats going after fewer and fewer fish," Bahen says. "It's practically im-

possible to compete in the offshore fisheries without electronics. This gear is so important to the commercial fishermen that many of them have gone so far as to buy back-up units, just in case something breaks down."

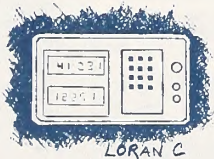
The shopping list for a commercial fisherman is often a bit longer than that of a recreational fisherman, but Bahen says the basic types of equipment are very much the same. The inset below gives a brief rundown of the most popular, and most useful, instruments.

But these are by no means the only electronic instruments in the cockpit. Side-scan sonar functions something like a depth recorder aimed forward and to either side, instead of downward. Transducers are mounted so that they pick up schools of fish in the surrounding waters.

"Side-scan is good for, say, a mid-water trawler looking for mackerel," Bahen says.

Fishermen sailing far offshore, around the continent or around the world, often add some other high-priced items

## The best sellers



LORAN C

Loran receivers pick up radio waves broadcast from towers onshore and, by comparing the signals, "plot" the position of the boat at sea. Loran A, a navigation system developed by the U. S. during World War II, gave way a few years ago to loran C, a more precise

system that can help a fisherman pinpoint a fishing spot at sea and then return to within a few hundred feet of the same spot, sometimes as close as 50 feet to a favored reef or wreck. The most sophisticated machines have computers that can remember the exact route a boat travels and, coupled with the automatic pilot, steer it along the same path next trip.

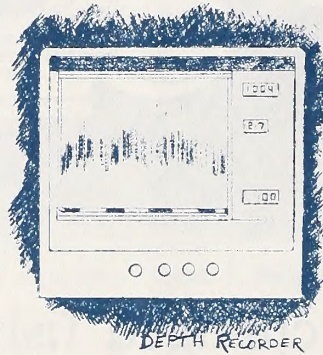
"Now, a captain can plug a course into his loran, go below and relax, and his boat will steer a straight course to the site," Bahen says. Price range: \$800 to \$4000.

VHF radio gives the captain radio communication with other boats, bases on shore, and with the Coast Guard, which monitors channel 16 for distress calls. NOAA weather radio broadcasts bulletins at 162.55.

"VHF has just about replaced the CB," Bahen says. "It has a much longer range, and a greater number of channels. Most of the boats now have VHF radios." Price range: \$129 to \$1000.



VHF RADIO

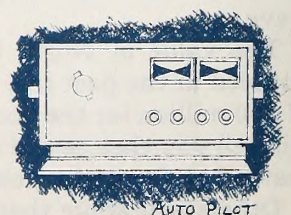


DEPTH RECORDER

Depth finders use an electronic transducer mounted on the boat's hull to broadcast sonic waves and then record and display the depth of the bottom and other objects under the boat. Depth "indicators" (price range: \$100 to \$500) report the depth of the bottom in numbers or display the reflected image of fish and bottom contours

on a screen. Depth "recorders" (price range: \$300 and up) print these images out on paper. Some units, priced from about \$1500, combine the two systems in one. The better instruments filter out noise from shafts and other gear for a "cleaner" picture. The most expensive types display the sonic picture in color, with different densities showing up as different colors. (See story on page 5.)

Autopilot frees the fisherman to do what he does best: fish. Autopilots are useful on big fishing boats and yachts. The modern autopilot electronically reads a course mapped in its computer, accommodates sea conditions, then turns the wheel. Alarms wired



AUTO PILOT





## Weather relay

*Jim Bahen, a Sea Grant marine advisory agent at Fort Fisher, uses VHF radio to receive weather information from fishing boats offshore. Bahen relays word of conditions to the National Weather Service, which uses the information to update its advisories, broadcast at 162.55 MHz*

to their list. A single-side-band radio gives tremendous range and keeps the captain in touch with stations thousands of miles away. "Weather facsimile" machines print out data and maps broadcast from the National Weather Service. Captains knowledgeable enough about meteorology can use the printouts to avoid bad weather

and to find the water conditions fish favor.

"If you wanted to look at a satellite photo of the Gulf Stream, you could turn the weather facsimile machine on at a certain time of day and get the print-out," Bahen says. "But you have to be able to read the map."

Captains who travel beyond the reach of loran transmitters need a second navigation system. Some subscribe to the Omega service, a privately owned network similar to loran but with transmitting towers around the world. Others pay thousands of dollars for machines that navigate their boats by signals beamed from satellites.

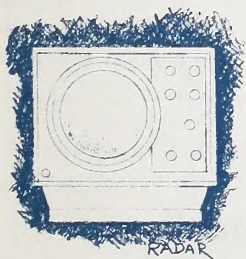
"There are more and more satellites up there, and satellite navigation is the thing of the future," Bahen says. "But right now, it's just too expensive for most fishermen." Some of the bigger boats have on-board microcomputers that monitor all their machines and gauges, record travel times and speeds, report fuel efficiency, and help the captain choose the best routes.

But it is not only the commercial fisherman who wants electronics. Bahen says that he has noticed a strong trend toward more electronics on smaller recreational boats.

"The sportsfisherman can get by with just a compass, and that should be the first thing he buys," Bahen says. "But if he's a serious fisherman and he loves to fish, he's going to have a good rod and reel, and he's going to want some good electronic equipment. Remember, he's competing too."

How much electronic equipment does a sportsfisherman need? And how much should it cost him? Bahen cites a typical case: the fisherman with a 23-ft. boat capable of going 25 miles offshore. He might have \$8000 to \$10,000 invested in boat, motor and tackle. Bahen says his first purchase, assuming he already has a compass, might be a medium-priced VHF radio. The next item would be a depth finder, either an inexpensive one with a digital indicator that will help the fisherman run unmarked inlets or, for the more serious competitor, a depth recorder. Then, if the boat has space for another antenna, the next piece might be a good loran unit for what Bahen calls "repeatability"—the ability to easily find the way back to

to sonar and radar equipment warn the captain of traffic or hangs. Before electronics, autopilots, or "iron mikes," were mechanical contrivances of pulleys and gears connected to a gyrocompass. The new machines are compact, reliable and expensive: over \$1000, and typically at least \$3000.



Radar units sweep the surface around a boat with radio waves beamed from transmitters mounted high on the boat. A receiver translates the reflected waves into bleeps on a screen. On fishing boats, radar is most useful as a safety device that warns the skipper of traffic, finds buoys and allows a trawler captain to keep an eye on neighboring boats, even in fog.

The two most important considerations in buying radar are power and discrimination. Powerful sets cost more, but power improves not only the range of the unit, but also its ability to define small targets at intermediate distances. Good discrimination in a unit allows it to separate objects close together—for example, boats fishing side-by-side. In general, the smaller the pulse length (the length of time taken for each burst of signals), the better discrimination.

It is best to mount a radar antenna as high as possible on a boat. However, doubling the height of the antenna will not double the unit's range. It will only increase the possible range by about one-third. Price: \$3000 and up.

*Continued on next page*



a rock or wreck that gave good results last time. The shopping list might look something like this:

VHF radio/antenna	\$300 to \$400
Depth recorder/transducer	\$600 to \$700
Loran receiver/antenna	\$600 to \$700

So, while the typical big-boat setup for a commercial fishing operation might require \$9000 worth of electronics, the small-boat, recreational fisherman might only invest \$1500.

Bahen offers some more pointers to the sportsfisherman who is interested in marine electronics: Choose a reputable dealer. Buy equipment that can be serviced locally. Ask the advice of experienced fishermen. And only buy what you can use.

"The guy who only goes out in his boat to do a little sightseeing once in a while doesn't need loran and depth recorders," Bahen says.

Bahen adds that, for now, it might even pay some fishermen to wait and shop around, before investing in marine electronics.

"The gear is changing all the time," he says, "and some of it is actually getting less expensive."

Mike Renn, who works in a marine-electronics shop in Wilmington, says that electronic gear is following the example of the pocket calculator.

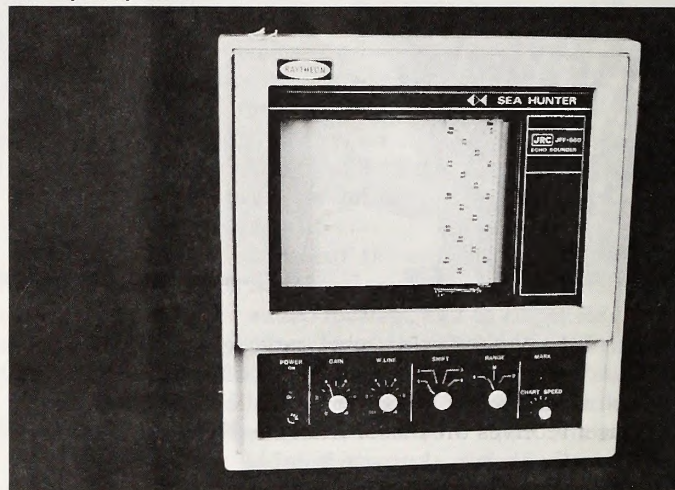
"They're coming down in price and down in weight,"

Renn says. He says that a few years ago a typical loran receiver sold for around \$3400 and was very bulky. A similar receiver now runs \$800, will do the same job, and may be half the size of its predecessor.

"Just because a piece is big and expensive doesn't mean it is better," Renn says. "You have to shop around and compare features to get the best value."

—Neil Caudle

Photo by Nancy Davis



One version of the depth recorder

Photo by Neil Caudle



## High-tech headboat

The pilothouse of a large North Carolina headboat sports an array of marine electronics, including autopilot and three different depth indicators. The depth machine mounted upper right was manufactured on Harkers Island



# Scoping the catch as it swims

With the flip of a switch, one piece of electronic wizardry—a depth recorder—listens to the sea beneath a fishing boat and shows the captain graphically what it hears: fish. He sees his catch before he ever lowers a net.

The depth recorder works like this: a transducer, mounted on the boat's hull, transfers electrical impulses into mechanical sound vibrations that are broadcast at millisecond intervals down into the water in a conical beam. When the vibrations strike objects in the water, such as fish, the pulses are reflected back toward the surface. The transducer receives the pulses and converts them back into electrical signals which are fed into the depth recorder.

By calculating the time it takes for sound pulses to reflect back from objects or the ocean floor, the recorder can produce a display on paper or on a color video screen that shows the fisherman a sketchy image of what is beneath him.

Depth recorders can determine water depths, record a graphic profile of the ocean floor, indicate the composition of the bottom and locate fish beneath the boat. Today's commercial and recreational fishermen consider this piece of electronics almost as valuable as their first mate.

more valuable fishes feed.

Depth recorders are also called echosounders or fish finders. But Kramer says the term "fish finder" is an advertising term. "A depth recorder, or fish finder if you want to call it that, doesn't find anything you don't run the boat over," he says.

To use a depth recorder fishermen have to do a little detective work to determine what kind of fish are being displayed. Recorders only provide clues fishermen can use along with their own knowledge of fish characteristics to make an accurate "guess" about the fish's identity. For example, fish with a swim bladder or air sac return stronger soundings than fish without the sacs.

Three types of depth machines are on the market—flashers, paper recorders and color scopes or "chromascopes." The flasher, the least sophisticated and least expensive, flashes the water depth on a digital readout as the boat moves along. There is no recorder, other than the fisherman's own memory. But the fisherman can tell if he is over a wreck, trough or reef, areas where fish might congregate. Duncan Amos, a gear and electronics expert with the Rhode Island Sea Grant Marine Advisory

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*"You're wasting your time if you fish without a depth recorder."*

*—Ken Kramer*

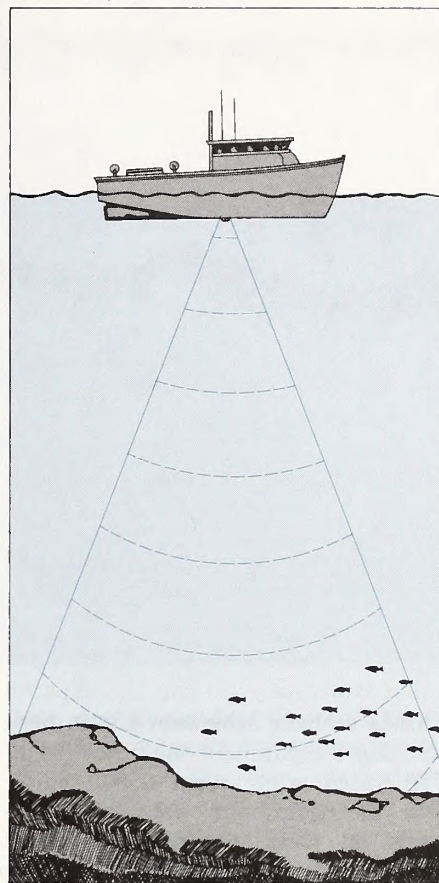
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"You're wasting your time if you fish without a depth recorder," says Ken Kramer, a Morehead City commercial fisherman. "If you don't have one, you're putting yourself at a disadvantage by not being competitive." Kramer has had his boat equipped with a recorder for ten years. Kramer bottom fishes. He uses his recorder to locate schools of fish and determine the composition of the ocean floor. He looks for areas with a hard bottom made of shell, rock or coral—one that attracts the baitfish on which larger,

Services and a columnist for *National Fisherman*, says fishermen have to watch the flasher very closely if they're going to be useful. A good flasher will cost about \$500, Amos says.

The paper recorder, the middle-range in expense and sophistication, graphically records a continuous profile of the area between the boat's hull and the sea floor on a strip of paper. Jim Bahen, Sea Grant's marine advisory services agent for the Wilmington area, recommends the

Illustration by Neil Caudle



*Transducers on boat's hull pulse sonic waves, recording the "echoes" of fish*

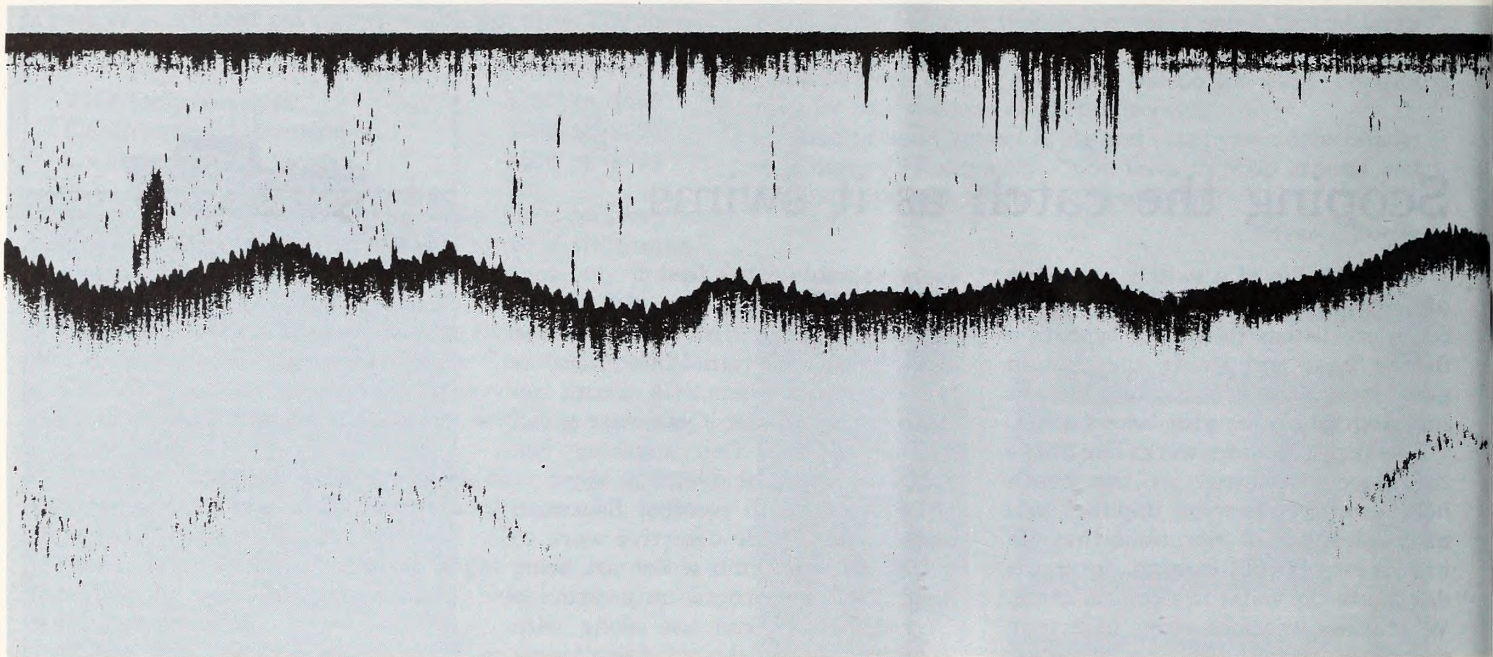
paper recorder over the flasher if the fishermen can afford it. Bahen says the paper recorder offers the advantage of having a record of the area covered. "The fisherman can take the paper out of the machine, write the loran coordinates for that area and return there if the fishing is good," Bahen says. Paper recorders range from \$300 to \$16,000.

The state-of-the-art in fish finders is the color scope. On a small, computer-like video screen the fisherman can tell what is between his boat and the bottom by differentiating between colors. Denser objects are displayed in bright red; less dense objects are shown in yellow, green, purple and blue. Blue is the background color that represents water.

A color scope will cost fishermen between \$2,000 and \$18,000. But like other expensive electronics, as more manufacturers produce color scopes, prices will begin to fall, Bahen says. Color scopes are luxury items that only a few North Carolina fishermen can afford now.

*Continued on next page*





Amos advises fishermen not to buy more depth equipment than they need. "Fishermen who spend \$5000 on a piece of equipment want a \$5000 return on their investment," Amos says. "That's why it is important for fishermen to get as much information as they can about the equipment before they buy."

Fishermen should consider these factors before choosing a recorder: the water depths at which fishing will take place, the fish being caught and the place on the boat where the transducer

will be mounted. Amos has written a 68-page booklet, published by the University of Rhode Island Sea Grant Program, that will help fishermen choose a depth recorder based on their particular needs. The booklet, *A Fisherman's Guide to Echo Sounding and Sonar Equipment: Acoustic Fish Detection Instruments*, is available for \$2 from the University of Rhode Island Marine Advisory Service, Publications Unit, Bay Campus, Narragansett, RI 02882.

Fishermen should also consider

several features when selecting a depth machine. Amos says the most important features are frequency, transducer beam angle and pulse length. The right combination of these features can mean a more accurate picture of the area beneath the boat and a better chance of finding fish.

For fishermen fishing shallow waters (less than 50 fathoms), a high-frequency depth recorder can be considered. But lower frequency recorders should be used for fishing in deeper waters and when fishermen need to determine the composition of the bottom. Many machines are now fitted with both a low and a high frequency, an ideal choice for the multi-purpose fisherman.

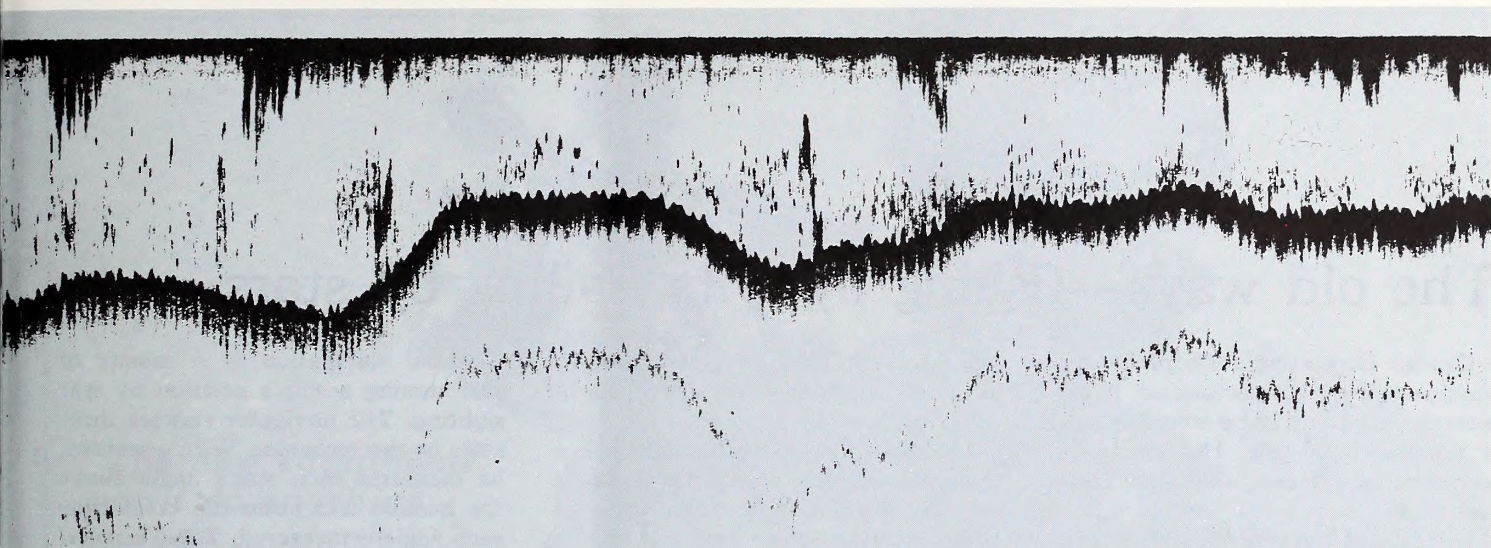
The beam angle of the transducer is one feature many fishermen overlook when selecting a depth recorder. Beam angles can range from 9° to 25° and affect the shape of the fish echoes on the recorder, the ability of the recorder to determine seabed composition and the ability to locate smaller fish at greater depths. Amos suggests selecting a wide beam angle for shallow fishing and a narrow beam angle for deep-water fishing. A wide angle for deep waters will show many more fish targets than a trawl could catch during a single tow; a narrow angle at shallow depths would limit the fish displayed.

Pulse length, the thickness of the sound wave transmitted by the transducer, can help a fisherman determine the size of the fish or schools of



Duncan Amos demonstrating a color scope





*Part of a depth recorder's printout: heavy line near center is the bottom; clustered specks at left turned out to be a school of Spanish mackerel; those at right were king mackerel*

fish located, if the device is used correctly. The wrong pulse length can make a small fish look like a large fish or schools of fish look denser than they really are. Amos says a shorter pulse length distinguishes smaller objects better and provides a more accurate representation of the fish's size. But the shorter pulse length can not be used continuously in deep waters without sacrificing the seabed profile.

For deeper waters, fishermen need a recorder with a variable pulse length or a phase-ranging feature. The variable pulse length allows the fisherman to temporarily shorten the pulse length to look inside a school of fish. Using phase ranging, the fisherman can focus on a particular section of the water column.

For fishermen buying a paper recorder, Amos suggests equipment that uses paper no smaller than four inches wide. The recorder compresses hundreds of feet of sea information into a few inches of recorder paper. For the most detail possible, fishermen should buy a recorder that uses wider paper.

Correct installation of the transducer can make a decided difference in how well the depth recorder works. The transducer should be mounted on the boat's hull in an area with minimum noise interference from the boat's machinery or from movement through the water. Amos suggests mounting the transducer one-third to one-half of the vessel's length from the stem post, preferably beneath the fish-storage area.

And, like a musical instrument, a depth recorder may need a little fine-tuning after installation. A fisherman should make sure he is very familiar with the recorder's variable controls before adjustments are made.

The gain control, probably the most important variable control, requires careful adjustment for the recorder to operate at peak efficiency. The gain control works like the volume control on a stereo, picking up more sound and from farther away as it is turned up. If the gain control is turned up too much it will register extraneous noises, such as vibration from the boat's engines, as schools of fish.

For fishermen wanting more detailed information about the seabed or midwater regions, add-on functions are available for some depth recorders. The most common "extra" is the seabed locked-scale expansion unit. With this feature, a fisherman can magnify the display of any area he chooses over a seabed. The expansion unit allows accurate measurement of the fish echoes and their exact depth above the seabed. Another expansion unit, the midwater expansion, magnifies an area of the water column, but the data is not locked to the seabed. Another add-on feature is the net sounder or net monitor, used to provide data on the performance of the trawl nets.

Depth recorders were developed prior to World War II for navigational purposes, says Amos. But during the

war, depth recorders were refined and used to look for enemy submarines and mines. After the war, an industry developed around these new electronics as manufacturers recognized their value to commercial fishing. By the late 1950s, most offshore commercial fishermen had installed depth recorders aboard their boats. Now every commercial and many recreational fishermen have at least one depth recorder and sometimes as many as four recorders, Amos says.

In the future more automation and computerization is likely for the commercial fishing industry, says Dave White, a manufacturing representative for Epsco Marine Systems of Seattle. "Instead of having six thousand boxes hanging from the ceiling giving loran, depth recorder and other information, it's all going to be in a . . . video computer console," he says.

White says he already knows about 20 West Coast fishermen who are using computers. "There is a fisherman in Seattle who put a computer on his boat and everybody laughed. What he did was enter all the information gathered while fishing into the computer," White says. "After two to three years of entering data, he was able to punch the computer, and, based on the day's conditions, determine the best places to fish. His fish catch actually increased 25 percent."

—Kathy Hart



# The old ways—fishing by wits, sailing by stars

George Bedsworth's *Dolphin I* is equipped with a newfangled depth recorder to let him know when his boat is passing over fish. His electronic navigational system guides him there and back.

But he still looks for the sight of diving gulls, still smells the air for the odor of fish, still watches for an oil slick that will tell of a school of fish. And, he can still navigate without fancy electronic equipment.

For nearly 50 years, Bedsworth has taken charters out of Morehead City. And for nearly as long, he's relied on his own senses to find fish and to find his way around the water.

It's only been in this generation that we've learned to rely on electronics for fishing and navigating. Bedsworth, just one fisherman who's been around long enough to learn the old and the new methods, says it's not time to throw away tradition yet. What electronics has done to fishing, he says, is to make it more convenient. Depth recorders will let you know if there are fish under the boat, but you've got to know where to find them first.

It takes time to recognize the signs of fish, says Bedsworth. A trained eye can spot the darkened blob of a school of fish. For example, menhaden swim in a tight bunch and appear black against the water.

A trained nose can sniff the smell of a school of fish. Bedsworth says he also watches for the oily film on the water's surface—the sign of a large school. And, the old standby of watching for birds feeding on fish still works, he adds.

It's not time to give up on the old ways of navigation, either, says Charles McNeill, director of the Hampton Mariner's Museum in Beaufort. He says he's amazed at how little navigating experience some of the younger fishermen and sailors have these days.

Traditionally, North Carolina fishermen have stayed close to shore,

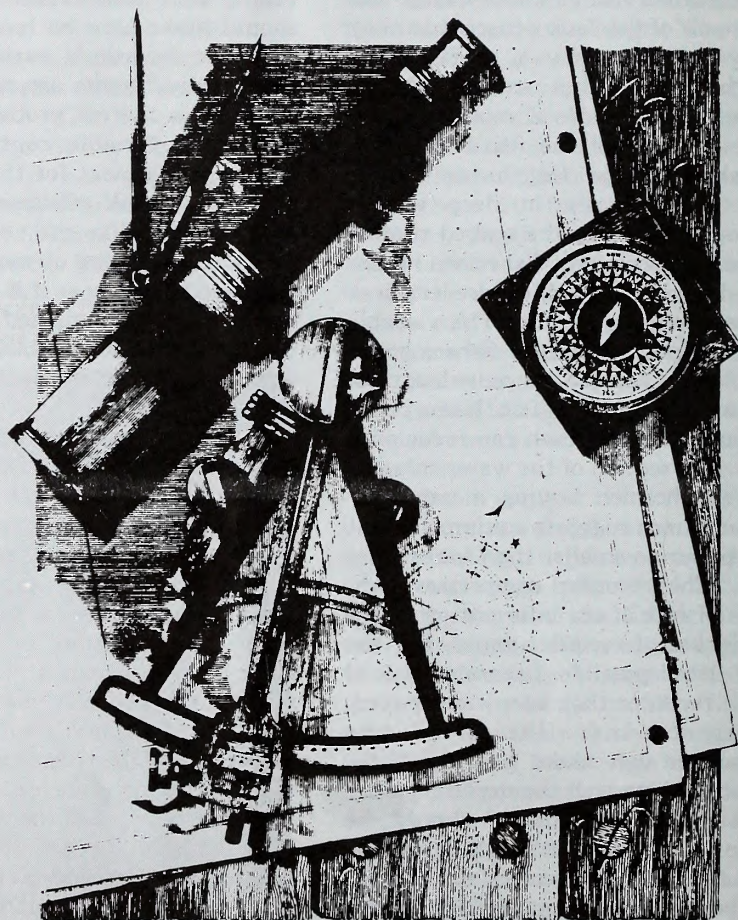
says McNeill. They used land bearings such as lighthouses for clues about where they were.

But trade vessels were sailing out of the state as early as the 1700s, using celestial navigation to guide them to their destinations, says McNeill.

Celestial navigation is a means of determining a ship's position by star sighting. The navigator chooses three stars he can recognize. With a sextant, he measures each star's angle above the horizon and notes the exact time each angle is measured. The *Nautical*

*"Electronics are subject to failure . . . But the stars will always be there."*

—Joe Snare

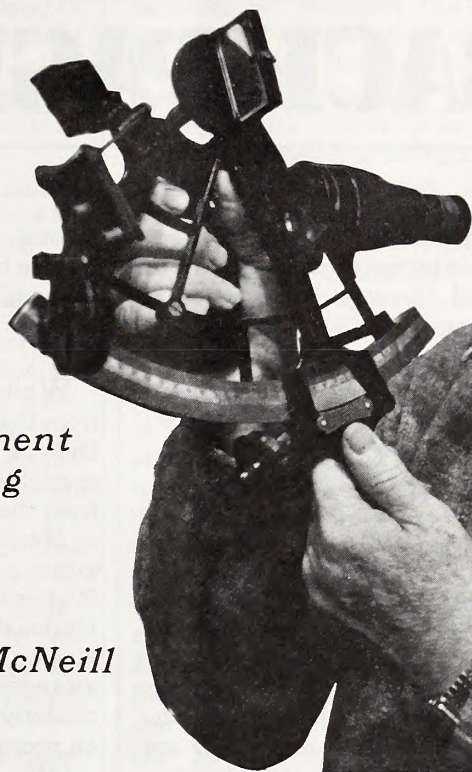


*Old-time tools of navigation: dividers, spyglass, sextant and compass*



*"The new equipment won't do anything the old wouldn't do. It's just easier now."*

*—Charles McNeill*



*Almanac* tells the navigator where each star is in relation to the earth's surface and he is able to determine his ship's position.

With celestial navigation, a boater can determine his position within one-eighth of a mile—without the use of electronics. "The new equipment won't do anything the old wouldn't do," says McNeill. "It's just easier now."

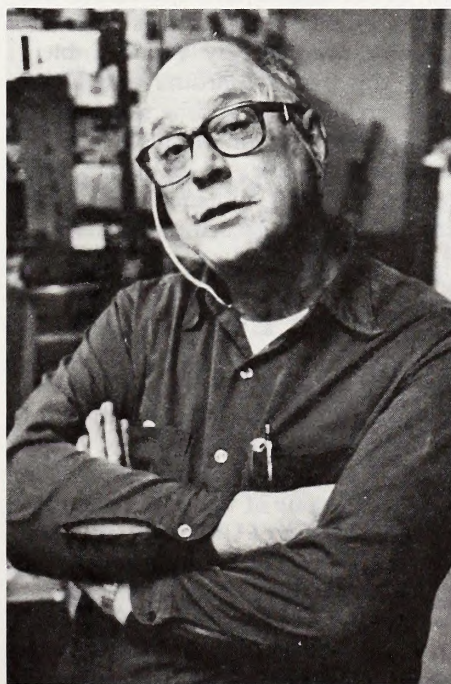
At the Morehead Planetarium in Chapel Hill, Joe Snare teaches recreational boaters the ancient art of celestial navigation. Many of his students' vessels are equipped with loran, but Snare says his students prefer to put their faith in the stars.

"Electronics are subject to failure, and when you're miles from nowhere, there's nobody to call to fix it," says Snare. "But the stars will always be there."

The view of the new electronics is the same from somebody who makes the gear. Jerry Barton, a Harkers Island electronics manufacturer, likes to talk about the gear's evolution. He points out that the first sonar of the sea belonged to the dolphin, which transmitted a sound and received the echo with its forehead. And the patent on celestial navigation belongs to migratory birds, which have been

found to use the stars to navigate on their journeys.

While sonars were around during World War I, they weren't used commercially until after World War II, says Barton. He boasts of being the only U.S. manufacturer of fish scopes. Unlike most depth indicators on the market today, Barton's fish scopes use



*Jerry Barton*

multiple transducers, allowing fishermen to tell if fish are to the left or right of the boat as well as directly underneath. The scope is also equipped with a bell that pings as it detects fish so that fishermen don't have to continually watch a screen.

Now, Barton is even working on an electronic sextant to help boat owners navigate by the stars, without having to do any computations. So, why do we need a sextant if we've got loran to navigate for us? Barton says that if the United States were involved in a war, navigational systems such as loran might be squelched.

When Barton began manufacturing his scopes, commercial fishermen in North Carolina were still using primitive gear and techniques, he says. It's improved since then, but Barton thinks there's still room for advances.

He expects fishermen of the future to be equipped with the most advanced fish scopes, deep water thermometers and salinometers to gauge the levels of salt in the water.

But even after his thirty years of working with electronic gadgetry, Barton concedes that his fish scope won't do much good unless fishermen know where to look for fish.

*—Nancy Davis*



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



The Albemarle shad boat may have seen some better days, but Mike Alford, curator of historical maritime research at the Hampton Mariner's Museum in

Beaufort, is trying to change that for one old vessel.

He and a boat builder from Beaufort are restoring a shad boat to its original 1915 state. But what took a month to accomplish then will take Alford at least six months, including time for researching the boat's construction.

Alford says, "The first shad boat was apparently built in the 1870s on the east end of Roanoke Island by George Washington Creef. And where he got his ideas from we don't exactly know, but the boat is unique and very successful and was rapidly adopted by fishermen on the Outer Banks and Roanoke Island."

Originally sail-powered, most of the shad boats were converted in the early 1900s to use automobile engines for power. These days, there are only about a dozen in use.

In its day the boat was a favorite of fishermen because of its distinctive round bottom and its unique style of construction.

"The boats are real seaworthy," says Alford. "Fishermen like them. They're safe and comfortable to work in rough water."

An international conference on sail-assisted commercial fishing vessels will be held May 15-16 at the Tarpon Springs Yacht Club in Tarpon Springs,

Florida. The conference will be sponsored in part by Sea Grant programs in Florida and Virginia. Registration is \$30 for commercial fishermen and \$60 for others. Register in advance by contacting John W. Shortall, University of South Florida College of Engineering, Tampa, Fla. 33620.



It's not unusual for Sea Grant agent Larry Giardina to advise a fisherman about taxes or Bob Hines to tell an angler how to maintain his gear. But what is unusual is that Giardina and Hines are doing their advising via the television set.

Giardina and Hines, the Sea Grant marine advisory agents at Bogue Banks, appear on Vision Cable channel 12 every other Wednesday evening at 7 p.m. in Carteret County. Their 30-minute show, called "The Sea Grant Program," focuses on topics of interest to the marine community—boat and gear maintenance, marine electronics, smoking fish and more. Other UNC Sea Grant agents and specialists will make guest appearances on the program, produced by Vision Cable.

On the weeks Giardina and Hines aren't on the air, the time slot is filled by a program from the N.C. Marine Resources Center at Bogue Banks. Center staff tell audiences about the state's coastal creatures and habitats.



Lundie Spence's "Oceans" course, taught as an interdisciplinary course at North Carolina State University, has been evaluated as one of the best courses in the Department of University Studies. Spence, UNC Sea Grant's marine education specialist, has been teaching the course during fall semester to about 30 college students since 1979. Spence teaches students about many aspects of the ocean environment—

coastal geology, estuarine ecology, marine biology, coastal history—often drawing on Sea Grant staff and researchers for their expertise.

While Spence was collecting kudos from the university, John Sanders, Sea Grant's marine weather awareness specialist, was collecting an award from the National Weather Service. In a March 23 luncheon, Sanders was given a Special Service Award from Richard Augulis, director of the National Weather Service Eastern Region, for increasing the public awareness about coastal storms, particularly hurricanes, through emphasis on preparedness and storm education.

"We feel John has heightened coastal awareness of hurricanes," says Joe Pelissier, deputy meteorologist-in-charge of the National Weather Service office in Raleigh. "We feel the next time a devastating storm like Hazel comes along, people on the coast will better understand the threat, know what things like storm surge mean and take the precautionary measures necessary." Sanders completed his two-year project in March.



Since 1978 a colony of endangered brown pelicans has nested on two dredge-spoil islands in the lower Cape Fear River. But for the last two years, erosion has threatened the homes of some 800 feathery residents of the islands.

"The south island is eroding much more rapidly than the northern island and is down to a level that I would estimate there would be probably no more than about a foot above mean high tide," says Jim Parnell, a biologist at the University of North Carolina at Wilmington.

Parnell, whose Sea Grant research has shown the value of dredge-spoil islands as nesting grounds for waterbirds, recently advised the Army Corps of Engineers on an effort to save the birds' homes. The Corps dumped



more dredge material on the island to raise it to a safer elevation. Without the extra dumping, "one good storm during the nesting season could wash out a hundred pelican nests very easily," says Parnell.

But Parnell adds the action by the corps wasn't strictly for the birds: a lot of wildlife lovers will benefit, too.



Sea Grant's newsletter, *Coastwatch*, has for the second consecutive year won top honors in international competition sponsored by the Society for Technical Communication (STC). The newsletter received the award of "Distinguished Technical Communications," first place in its category. *Coastwatch* is edited by Neil Caudle; Kathy Hart and Nancy Davis are staff writers.

Another UNC Sea Grant publication, *A Homeowner's Guide to Estuarine Bulkheads*, placed third in its category and received the society's "achievement" award. The booklet, which advises coastal property owners on ways of mitigating the effects of estuarine shoreline erosion, was written by Spencer Rogers, UNC Sea Grant's coastal engineering specialist and illustrated by Deborah Ford, a member of the Sea Grant staff at Ft. Fisher.

These two publications, along with three others from UNC Sea Grant, also won awards in regional competition sponsored by the STC's Carolinas Chapter.

To help fishermen avoid costly hangs, Sea Grant has just updated its book, *Hangs and Obstructions to Trawl Fishing*. The book was compiled from the records of trawler captains, who were willing to share their hang logs with others. It lists hangs by loran headings and covers waters off the Atlantic Coast from Cape Cod to Florida.

If you would like a copy of the hang log book, send \$2 to Sea Grant, Box 5001, Raleigh, N. C. 27650-5001. Ask for UNC-SG-83-01.

Sea Grant's waterproof fishing maps have been revised and reprinted in time for spring fishing. The first chart shows fishing locations near Masonboro Inlet on one side, and has

locations off Beaufort Inlet on the other. The second chart covers the waters around Roanoke Island and those off Oregon Inlet.

Both charts include loran headings and are designed as a navigational aid. They are place-mat size. For your copy, send \$1 for each chart (or \$2 for the set of two) to Sea Grant, Box 5001, Raleigh, N. C. 27650-5001. Be sure and specify which chart you're ordering.

Aquaculturists—if you're interested in raising mountain trout, or curious about how it's done, a new publication from the N.C. Agricultural Extension Service might interest you. The booklet is called *North Carolina Mountain Trout Production: Investment and Operating Cost Estimates for a Trout Production Enterprise*. It was written by Jim Easley, an NCSU extension economist and Sea Grant researcher. Copies of the booklet may be obtained by writing Easley at the Department of Economics and Business, North Carolina State University, Raleigh, N.C. 27650-5576.

North Carolina State University Chancellor Bruce R. Poulton provided

written testimony to the U.S. House of Representative's subcommittee on Oceanography in April. Poulton wrote on behalf of the reauthorization of the National Sea Grant College Program (House Bill 1643), pending before the House Committee on Merchant Marine and Fisheries, chaired by Representative Walter Jones, D-N.C. The Sea Grant Program was created by an act of Congress and must periodically be reauthorized by Congress so it can continue to operate as a federal program.



Fishermen are always looking for ways to increase their catch. That's why Wayne Wescott, Sea Grant's marine advisory agent on Roanoke Island, and

Murray Bridges, a Collington crab shedder, are testing a peeler pound, a net used by Chesapeake fishermen to catch hard crabs and peeler crabs. Chesapeake fishermen report the net catches more hard crabs and peeler crabs than crab pots or peeler pots. Wescott and Murray want to find out if that information holds true for

*Continued on next page*

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, Box 5001, Raleigh, N.C. 27650.

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—Mass media

—Educator

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—Farming

—State government

—Homemaker

—University professor/researcher

—Lawyer

—Other \_\_\_\_\_

Coastal property owner ☐ yes ☐ no Boat owner ☐ yes ☐ no



North Carolina waters. They will begin testing the net this spring. The team will also be weighing the costs of the using the nets against the costs of using pots. And they'll be trying to find out where the nets work best.



For a crab processor, cooking a crab for eight minutes and cooking it for 15 minutes could mean the difference between making it or breaking it in the business.

Bob Pittman, a partner in Osprey Seafoods in Chocowinity, likens cooking crabs to cooking hot dogs. "You take a hot dog and put it in the microwave for one minute and everything is just right. But you put it in there for ten minutes and it'll come out all shriveled up."

That's what was happening to crabs at the seafood plant when Pittman and his partner bought the company in September. "We were just overcooking the crabs and driving all the moisture from the meat," says Pittman.

So Pittman called on Sam Thomas, a Sea Grant seafood specialist at the North Carolina State University Seafood Laboratory in Morehead City, to evaluate the cooking process at the plant.

Thomas set up thermometers inside the cookers to monitor the temperatures while the crabs were cooking. He found that the entire cooker was overheating, improperly ventilating and causing excessive pressures.

Most cookers operate under 12 to 15

pounds of pressure per square inch. "When you contain that inside a vessel like a crab cooker, the pressure buildup inside on the walls and doors is tremendous," says Thomas. In this case, pressures were higher than they should have been and could have been dangerous.

The solution? Thomas estimated the optimum temperature and pressure over an eight-minute period and recommended venting the cooker and adding bleeders or small openings to allow steam to escape.

Those recommendations made the system safer and more efficient, says Pittman. Now, instead of yielding nine pounds of crab meat for 100 pounds of crab, Pittman says he gets 10 pounds of meat for the same 100 pounds of crab.

That may not sound like much, but consider that it's not unusual for Pittman's company to process 10,000 pounds of crab in one summer day.

If crabmeat were \$6 a pound, that one extra pound of crabmeat he gains is a savings of \$6 per 100 pounds or \$600 in one day.



Sea Grant has just published a series of working papers and technical reports. *Modeling Estuarine Migration and Abundance of the Brown Shrimp (Penaeus Aztecus) of Pamlico Sound, North Carolina*, by Marc-david Cohen and George S. Fishman of the Curriculum in Operations Research and Systems Analysis

at the University of North Carolina at Chapel Hill, develops a series of models that examines the in-migration of brown shrimp to the estuarine nursery and the out-migration of shrimp from the nursery to fishable areas. The models are part of a larger study designed to develop methodologies for evaluating fishery management policies. For a copy of this working paper, write UNC Sea Grant, Box 5001, Raleigh, N.C. 27650-5001. Ask for publication UNC-SG-WP-83-1. The cost is \$2.75.

*An Evaluation of Five Types of Binders to Improve the Artificial Diet of Young American Eels*, by James F. Salevan of the North Carolina State University Department of Zoology, examines and evaluates five types of binders used in the preparation of feeds for American eels under culture. For a copy of this publication, write UNC Sea Grant. Ask for publication UNC-SG-WP-83-3. The cost is \$1.25.

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## COASTWATCH

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# COAST WATCH

Photo by Gene Furr



*Was the Phantom real? Sometimes he wondered. She had never been captured, and the roundup men did sometimes tell tall tales. Some had said she was a dark creature, dark and mysterious, like the pine trees. And*

*Continued on next page*



*some said she was the color of copper, with splashes of silver in her mane and tail.*

These lines from Marguerite Henry's *Misty of Chincoteague* have struck a chord in many a boy or girl who loved the idea of wild ponies roaming free on a wind-swept seacoast island. And for generations the legends of two Maryland and Virginia islands, Chincoteague and Assateague, have been the stuff of youthful dreaming.

Less celebrated, but no less wild and romantic, are the "banker horses" of North Carolina's barrier islands. From Corolla to Carrot Island, the feral herds have made the banks their home, grazing the salty marsh grass, struggling to live where only the tough survive.

Scientists call them horses, descendants of the small, sure-footed steed of Spanish conquistadors. And because of the horses' size, people Down East have for years spoken of the herds with affection as "ponies."

Nobody knows exactly how they came to the islands. Did they swim to shore from 16th century Spanish shipwrecks? Did they arrive with an ill-fated Spanish colony, even before the English did?

However they first came, we know that one of the first uses of the Outer Banks was for free-range grazing, not only for horses but also for cattle, sheep and goats. Islanders sometimes rode the horses, or worked them, or sold them away to small farms on the mainland.

The days of the plow horse are gone, but the horses remain. On Ocracoke, they grow sleek and pretty in their fenced pasture, under the care of park rangers. Each year, they draw thousands of tourists. But on Carrot and Shackleford, they roam free, unkempt and mostly unnoticed, wild as the wind.

Photo by Nancy Davis



*Grazing in Shackleford's salt marsh*

And now, after hundreds of years on these islands, the future of some of these herds is in doubt, and officials face tough decisions about what should be done.

This month, *Coastwatch* looks at the free-spirited horses of North Carolina's Outer Banks.

Photo by Neil Caudle







*Ocracoke's horses still bear the features of their Spanish ancestors*

## Meet the kin: Mr. Bob, Paint and Owen K. Ballance

There's a family, a special breed you might say, who has survived, generation after generation, on Ocracoke Island. While no one is sure how they arrived there, it is believed they have been island residents for over 400 years. Bringing to Ocracoke a hot-blooded Arabian ancestry and an intelligence born of Spanish breeding, the family adapted to the harsh environment of the banks, weaving their family history intricately into the fabric of the island culture and history.

Ocracoke's first family is not human, but equine. They're a herd of Spanish horses, whose ancestry combines the breeds of Arabian, Barb, Andalusian and Spanish stock horse to make a horse coveted for its endurance, adaptability, strength and intelligence.

The Spanish conquistadors brought hundreds of the horses to the Americas during the early years of exploration. They took so many of Spain's prized stock that the Spanish emperor placed a ban on further export of the horses in 1520. But by then, breeding farms had already been set up in Cuba, Puerto Rico and Santo Domingo to supply the Spanish with horses.

But just how these Spanish horses got to Ocracoke is the cause of great speculation. Spanish fleets, carrying cargoes of newly found American riches, often traveled a route which carried them close to Cape Hatteras and Ocracoke. Some say one or more of these ships wrecked, leaving a small herd that survived and flourished. And others believe they were left by an expedition led by Sir Thomas Grenville, an Englishman.

In her search for the horses' story, Jeannetta Henning has found old histories that talk of a Spanish settlement in 1526 in the Cape Fear region of North Carolina. Jeannetta has worked with her husband, Jim, a park ranger, to care for the horses and has spent seven years researching their heritage. The Spanish histories, based on the logbooks of exploration voyages, note that 500 people and 80 or 90 horses settled the area in July of 1526. According to the logbook, the colony failed later the same year. Jeannetta believes the horses were left behind, and she thinks the herd eventually spread up the Outer Banks. But no matter how the horses arrived, they survived, adapted and multiplied.

Horses were common along the Outer Banks during the 1600s. Many colonists used the islands to not only graze horses, but to graze sheep, cattle and goats as well, says David Stick, Outer Banks historian. But for the most part the colonists were absentee landlords, who did not live on the Outer Banks. It was 1715 before Ocracoke village, then called Pilot Town, was established.

The horses, often called banker horses or ponies, roamed the island in herds, says Jim Henning. They ate marsh grass and drank fresh water from holes they dug in the ground.

Each herd had a boss mare who led the herd in flight and to food, says Jeannetta. The boss mare was the first to eat and the first to drink. Each herd also had a stallion who protected the mares and the young, and kept the herd orderly.

The herd stallion was an excellent father to his young, and the colts and fillies actually spent more time with the stallion than with the mare, says Jeannetta. But when a young male reached two years of age the head stallion drove the male out of his herd.

*Continued on next page*



*"It was the only place I knew where the people were fenced in and the horses allowed to run free."*

*—Jim Henning*

"It was nature's way of keeping the horses from inbreeding," Jeannetta says.

Many of the Ocracoke villagers once owned one or more of this Spanish herd. Some of the horses were broken and trained for riding, plowing and pulling the carts that delivered grocery orders every Saturday, says Jeannetta. The Life Saving Service rode them to patrol the beach and haul wood washed up from shipwrecks.

Each July Fourth, islanders herded the horses together, branding colts and picking out some of the older horses for sale or training.

Lawton Howard, who grew up on Ocracoke and retired there 16 years ago, remembers the pennings that took place next to the island's only school. About 15 men would leave the village late on the night before the Fourth and ride to the north end of the island, Howard says. At daybreak the men would begin herding the horses southward. Some of the horses escaped roundup by swimming into the sound,

Howard says. By around noon on the Fourth the men would herd the horses into the village and the pen that awaited them by the school.

"There were a coupla fellas here that caught the horses with their bare hands," Howard says. "No one believes me when I tell them that. But it's true. My father, Homer Howard, was one of 'em. They would grab the horses by their mane, then throw one leg in front of the horse's legs so they wouldn't get trampled. They'd grab their nostrils and hold on until the horse was out of wind and could be roped."

To break the horses, villagers would fill an old pair of pants with sand and place it on the horse's back, Howard says. Sometimes the islanders blindfolded the horses to keep them from kicking and rearing as they broke them. Or they stood the horses in water, where it was impossible for them to kick, he says.

Once broken the horses are a gentle lot, says Jeannetta. "They're very

human oriented," she says. "They're highly tuned, sweet-tempered and not nervous. They'll nuzzle right up to you. A lot of the people here on Ocracoke grew up with at least one of the horses in their backyard."

The horses took on a new prominence in the 1950s when *Boys Life* magazine discovered the Ocracoke Boy Scout troop was the only mounted troop in the country. Each scout trained and cared for his own mount. "The national publicity stirred a great deal of feeling for the horses here on the island," Jeannetta says.

In 1957, when the highway was built that ran the length of the island, the horses were corralled for the first time. Until then, villagers had surrounded their yards and homes with wooden fences to keep the horses out.

"It was the only place I knew where the people were fenced in and the horses allowed to run free," Jim says.

After the highway was completed, the Boy Scout troop took over care of the small herd. The scouts looked after the horses until the late 1960s when the U.S. Park Service took over the care because the troop had dwindled and the expenses had become a burden.

When the Park Service took over the horses, the herd was on the decline. At one time the herd was as low as nine horses, Jim says. Jeannetta raised three foals by bottle to keep them alive, he says. A breeding problem had developed.

The remaining stallion and three of the mares were not compatible mates. The result was foals born with a condition called hemolytic anemia. The mare's milk contained antibodies that destroyed the red blood cells in the foals, which died soon after birth.

Dr. Thomas Bruce, director of the state's Animal Disease Diagnostic Laboratory in Edenton, says the disease is not uncommon. Bruce says inbreeding contributes to the disease's occurrence, but is not the cause. To solve the problem, an Andalusian stallion was brought in for breeding purposes. Since the stallion's arrival three healthy foals have been born, Jim says.

While Bruce studied the horses' health problems, Dr. William Stabler, a Houston, Miss., veterinarian and an examiner for the Spanish Mustang Registry, has been studying the horses'

Photo by Cassie Griffin



*Jim Henning chatting with a neighbor*



bone structure and their similarity to old Spanish breeds. He says at least 10 horses in the herd are purebreds. They have five instead of six lumbar vertebrae, a distinct characteristic of the Spanish horse. Upon Stabler's recommendation, the horses were recognized by the Spanish Mustang Registry.

A mixture of circumstances kept the bloodline of the horses pure. The horses tended to reject mates of different breeds. And the isolation of Ocracoke made it hard to transport horses on and off the island. Also many islanders took pride in the horses' Spanish breeding and wished to keep the bloodline pure, Stabler says.

And fate, says Jeannetta, may have added to the horses' purity. One mixed-breed herd was killed during a hurricane that struck the island, she says. Others were sold. And several horses brought to the island for breeding died because they could not withstand the swarms of salt-marsh mosquitoes and green-head flies and a diet of tough salt marsh grass.

"You can tell a Banker pony as far as you can see it," Jeannetta says. "They have a short back. They're short-legged and thick chested. They have a proud neck and a long tail and mane. It's only when you get close to them that you can see the Barb, the Andalusian and the Arabian in their faces and shapes."

The size of the herd has risen back to the 21 horses present today. And now each horse carries a name—Paint, Mr. Bob, Rainbow, La Baronesa, Owen K. Ballance. The herd is kept for the most part in an 168-acre pasture, just off the highway that runs between the Hatteras ferry landing and Ocracoke village. Observation stands have been constructed by the Park Service for visitors to view horses.

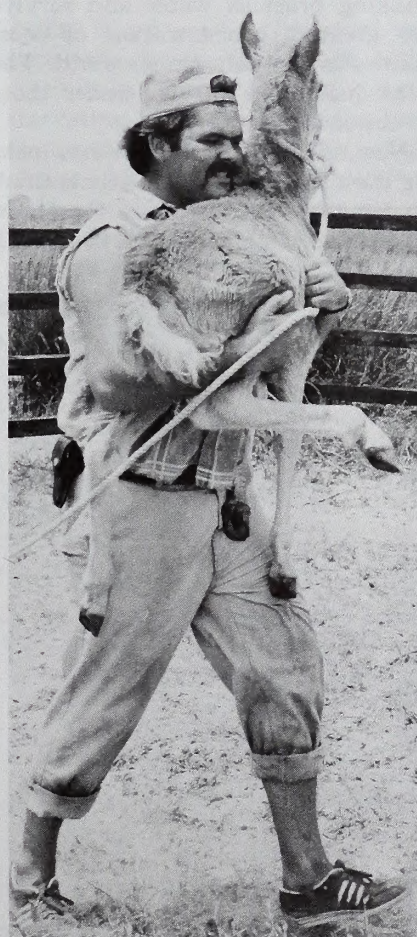
But the islanders still call the horses their own. "The people here know they have something unique, something as much a part of Ocracoke as they are," says Jeannetta. "A debate rose when the Park Service considered training a few of the horses for beach control. Several people thought the horses should not be worked. But one Ocracoke old-timer spoke up and said, 'Look at it this way folks, I never had the urge to walk up to one of those Parks Service jeeps and pat it on the head.'"

—Kathy Hart

Photo courtesy of Division of Archives and History



## Roundup on the banks



*For generations, people—mostly from Harkers Island fishing families—have gathered once a year on Shackleford Banks to pen and brand the island horses. A photo from 1907 (above), "Catching a wild pony," by M. B. Gowdy, captures the flavor of fisherman-turned-cowboy.*

*Early roundups supplied local farms with plowhorses and island families with some income. Today, the roundups continue, but mainly to keep a tradition alive. Each July, the herders fan out on Shackleford's wooded west end, driving the horses toward a pen on the eastern grassland.*

*For the rest of the year, people leave the horses alone. And foals like the one at left, though they may wear a brand, spend their lives running free on the island.*



# Who'll decide horses' future—nature or man?

A sorrel mare dips her head into brackish marsh water to pull up fresh shoots of sea grass. It's spring and she's survived on tough dune grasses for most of the winter. Here and there lie the carcasses and bleached bones of several horses that didn't make it through the winter. Perhaps they mired down in marsh mud and were too weak to pull themselves out.

Across the marsh, another mare is grazing. This one has a foal by her side. It was probably born a few months before, the toughest time for the horses—the time when food is running out and the fresh grass hasn't begun to grow yet.

The horses of Shackleford Banks and Carrot Island survive in a harsh environment. They eat the salty grasses and paw in the sand for a sip of brackish water. In the summer, they stand in 100-degree weather and endure biting flies and swarming mosquitoes. In the winter, they seek shelter behind the dunes from freezing winds, their coats becoming thick and shaggy. But somehow, the horses have adapted to the island's harsh environment.

Daniel Rubenstein, a Princeton biologist, says that islands, because of their ruggedness, extreme climates and fluctuating freshwater levels, "provide habitats that must be adapted to in

novel ways."

Rubenstein says he has watched banks horses drink salt water—an adaptation that would probably indicate some drastic modification in the horses' kidneys. But no physiological studies have been done on the animals, and at least one doctor is skeptical.

"That the horses could drink salt water is beyond the realm of comprehension. I think it's a myth," says William B. Blythe, professor of medicine at the University of North Carolina in Chapel Hill.

The horses have adapted to a place where fresh water and food are both in short supply. They've learned that if they dig deep enough, sometimes as deep as four feet, they'll find a few sips of fresh water.

It's a life where only the strong survive. John Funderburg, director of the North Carolina Museum of Natural History, says, "Over the years, there's been rather rigorous selection for those who could survive the heat, adapt to drinking brackish water and survive the greatest concentration of mosquitoes in the salt marsh world. The weak just don't survive under those conditions."

Now, after years of the horses making it on their own, some people think it's time to start managing the herds. At least two scientists think

Shackleford Banks and Carrot Island may reach carrying capacity in the future. For others, managing the horses means an end to one of the few remaining examples of a free-ranging wild herd.

Local residents, most from Harkers Island, claim the horses, goats, sheep and cattle that roam Shackleford. Each year, around July Fourth, they round up the horses, pen them and brand the foals. The horses are a part of the heritage of the Outer Banks and a tradition some folks are afraid may be slipping away.

Sentiment has been aroused by recent talk of a National Park Service Plan to remove the animals from Shackleford Island and to leave a "representative herd" of horses.

But Preston "Mack" Riddel, superintendent of the Cape Lookout National Seashore offices, says it's premature to discuss the fate of the animals. The Park Service is in the process of purchasing Shackleford for inclusion in the Cape Lookout National Seashore. So far, though, only about 500 acres of the total 3,000 have been purchased.

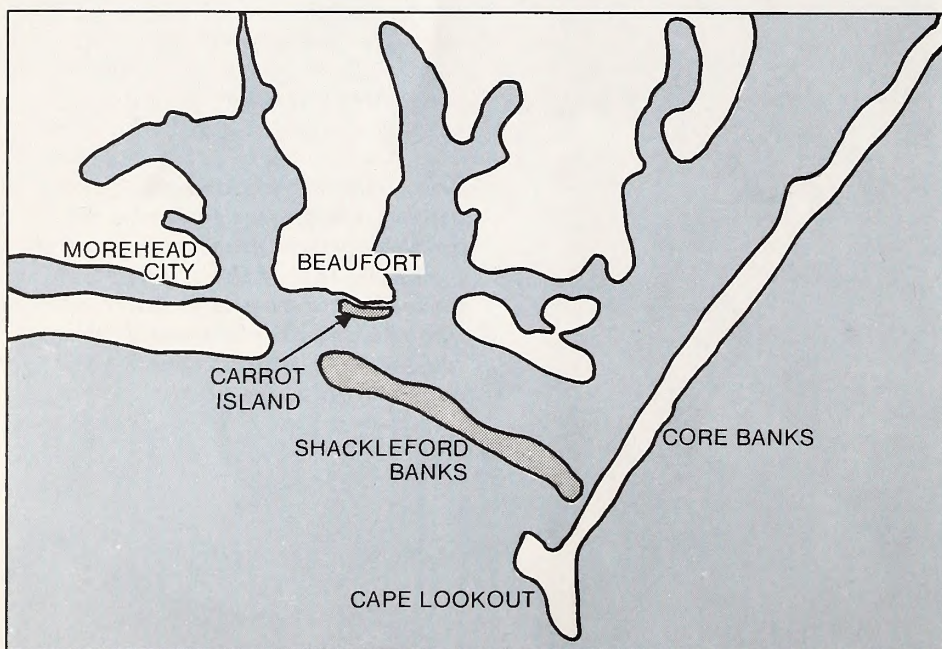
"From our studies thus far, it appears the goats, cows and sheep should be removed and a representative herd of horses should remain. But that could be a year, two years or even three years away. Many people think it's going to happen tomorrow and it's not," says Riddel.

One of the problems in setting policy for Shackleford once the purchase is complete will be that scientists disagree on how the island should be managed.

Gene Wood, wildlife ecologist at Clemson University's Belle W. Baruch Forest Science Institute, conducted a four-year study for the Park Service to determine the impact of the animals on the island. He concluded that if the number of animals continued to increase, they would practically denude the island of vegetation.

The sheep and goats are likely to cause the most damage to vegetation, he says. "Sheep, in winter months, will even dig out the roots of plants, completely destroying them so they can't grow the next season."

The goats mainly influence the maritime forest, keeping vegetation



Where the wild herds are—tiny Carrot, remote Shackleford



closely trimmed and nibbling bark off the trees. Without the goats, the forest wouldn't be penetrable by man, says Wood.

Cattle and horses graze mainly in the grasslands, with the cattle preferring the upland areas and the horses opting for the salt marshes when they are green.

To determine the impact the animals have on island vegetation, Wood set up exclosures to keep them from grazing on small one-tenth-acre areas. In exclosures in the marsh, he found that "the areas would produce substantial amounts of cordgrass if the animals weren't grazing."

Wood says his studies show that the animals should be removed from the island to avoid over-grazing. "But, because of the possible historical links of the horses, a lot of people will demand they be left on the island. If that is done, the number of horses that will be maintained must be matched by the island's ability to feed them."

Wood says his data suggest the horse herds are increasing by 15 percent each year. In a 1980 aerial survey, he counted 108 horses, 74 cows, 144 sheep and 65 goats. Since those are numbers of animals he actually saw, Wood estimates the populations are probably higher, particularly for the goats, which often graze in the forest.

Rubenstein, who's been studying the horses for the past 10 years, disagrees with some of Wood's conclusions. He says, "The population maintains itself. They are not overgrazing the island." In the past 10 years, the horses have maintained a steady population of about 100, he says. He attributes the slight rise in the population in recent years to a few hard winters during the late 70s. Then the numbers were reduced to about 83 and the population has been recovering since then, not actually increasing, he says.

Rubenstein says that nature is doing an effective job of managing the horse population, without the help of man. He says the horses won't increase their numbers beyond what the island's resources can support.

Rubenstein says the horses are unique, that their value to science depends on their being left alone. Any management, he says, even so much as removing part of a horse herd from Shackleford, will destroy the natural scientific laboratory the island offers. "If they manage it, it's no laboratory."



Photo by Nancy Davis

*Will banker horses eat themselves out of house and home? Scientists disagree. Studies using exclosures such as the one above showed grazing by all the animals was severe. At right, the remains of one horse that didn't make it.*



But Wood predicts eventual over-population of the island, tremendous attrition in animal condition and mass starvation if the populations aren't managed. "In my opinion, letting nature take its course would be a serious mistake," Wood says.

Another scientist, Rolf Hoffman, predicts a similar doom for the horses on Carrot Island. As a Duke University graduate student in biology, Hoffman wrote, "The results . . . indicate that Bird Shoal-Carrot Island may reach its carrying capacity for large mammals in the foreseeable future." He recommends the state develop a management plan to avoid over-population, deteriorating health of the animals and the eventual destruction of their habitat.

The state recently purchased Carrot Island for inclusion in the N.C. National Estuarine Sanctuary.

According to Hoffman's figures, there were 24 horses on Carrot Island in 1977. By 1982, that number had grown to 50. Hoffman says that if that growth rate continues, the population would reach 80 by 1985, resulting in over-grazing of the island, an increased shortage of water and higher competition for good grazing areas. He proposed keeping the population to 50

horses by removing five to eight foals each year.

Bill McElyea of the Office of Coastal Management, says a management plan is being developed for Carrot Island. "We'd like to let the horses remain because they're a part of the aesthetics of Carrot Island. People in Beaufort have a strong attachment to Carrot Island and to the horses. We're going to encourage further research regarding the horse population," says McElyea.

But there may be a complication in the state's attempt to manage the horse population on Carrot Island. A Greensboro man says he owns the horses and would like to leave them there.

Whatever the fate of the horses on Shackleford Banks and Carrot Island, it is sure that they are both a tourist attraction and a sentimental tie to the past. Each weekend during the summer months, 83-year-old Grayden Paul boards a double-decker English sight-seeing bus and leads tourists through Beaufort. He points out the horses which roam Carrot Island across the water from Beaufort and says, "I was born and raised right here with those ponies."

—Nancy Davis



# Slash Star and the harems of Shackleford

For the first four years of his life, the colt Slash Star has roamed the grassy swales and marshes of Shackleford Banks with the herd—the harem—of his father. Now it is time for him to leave and make his own way.

He gallops past the dunes, over the tough cordgrass, stopping once to paw the damp sand and sip fresh water as it collects in the hole. Soon he reaches the limit of his father's domain, a line marked only by a few low shrubs, some piles of dung. He crosses the border.

For several days he lingers there, grazing on the fringes of another stallion's territory. The stallion glares out through a shock of wiry mane; he herds his harem away from the intruder. Slash Star grows bolder, grazing nearer to the herd.

Suddenly, the stallion charges, head up, his flaxen mane waving like a banner. His ruddy coat is stiff with salt spray. His flanks are scarred. As he meets the colt they snort, wheel, lay back their ears and mark the ground with their scent. Soon their hooves are flying, the stallion rearing high to flail the air.

There is no clear winner. Slash Star is agile and exceptionally strong, but the older stallion has earned his place with skill and savvy. After several days of testing one another, the stallion holds his ground, but cannot run the colt away.

At last, they reach an understanding. Slash Star can stay, but only as the stallion's helper, an apprentice. He will have no mares of his own.

Things go smoothly for several months. Day after day, Slash Star charges out to help defend the harem's borders. Sometimes the fights are vicious; his bleeding jaws sting when he drinks in the salt

marsh. The stallion fights too, but now he has more time to rest, to graze, to groom his herd. The colt is learning to fight.

One day, when the older stallion is away defending their border, Slash Star mates with one of the mares. When the stallion returns, he too mates with the mare, as if reclaiming her.

Slash Star has broken the pact, and he will again. Before very long, he and the harem leader will battle for control of the herd. The loser will be banished.

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The story of Slash Star first appeared, not in the pages of romantic fiction, but in a scientific journal. The original account of his coming-of-age, written in the more objective and scholarly prose of a scientist writing for scientists, was the work of Daniel Rubenstein, a Princeton University biologist who specializes in behavioral ecology—the study of how animals' behavior relates to their environment.

For the past ten years, Rubenstein has spent much of his free time on Shackleford Banks, traipsing the sands and wading the marshes with his students, jotting notes about the wild ways of the 100 or so feral horses there. He knows them all, he says, by their markings and by the names he gives them—Big Red, Slash Star, Squiggle Face and JJ. And he calls the social order among Shackleford horses “unique.”

“The horses there set up territories and defend them,” Rubenstein says. “They don't do that anywhere else. Shackleford is a natural laboratory of animal behavior.”

Each year since he first studied the island as a graduate student from Duke University, Rubenstein has watched the harem leaders defend their borders, which never shifted more than fifteen or twenty meters. Then, in 1980, the laboratory turned upside down. What happened on Shackleford was nothing short of revolution—the violent overthrow of a great social order.

“The harem leaders were getting older, and at the same time there was an increase in the number of bachelor males,” Rubenstein says. “Some of the young turks took over, threw the old stallions out, and divided the mares up among them. Now there are no big harems and no territories, only small herds and overlapping ranges.”

But Rubenstein expects to see the territories reassert themselves.

“My hypothesis is that the strongest of the stallions will begin to take mares away from the rest, and when it's economical, they'll set up the territories again.”

Photo by Neil Caudle



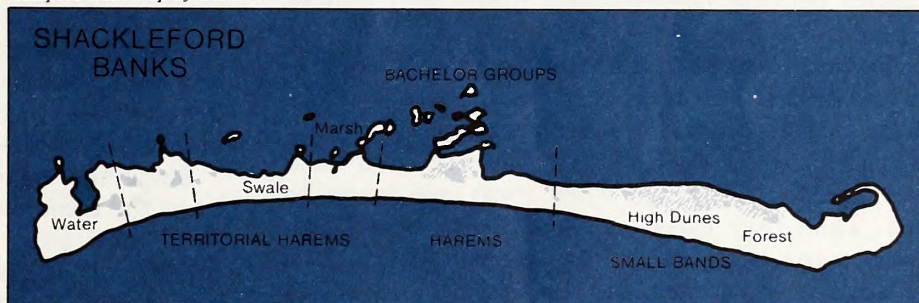
*Stallion wearing the scars of battle*





*Shackleford horses, like the three youngsters above, leave their natal herds when they are ready to breed. Map at right shows the island's social organization before the takeover of 1980. Four harem-masters kept territories in the grassy eastern end, while bachelor groups and two roving harems shared the island's center.*

*Adapted from map by Daniel Rubenstein*



He thinks the territories came about because they served the interests of the herd. And Rubenstein has found that the quality of life in the territories is actually better in some ways than the life outside. He explains why by pointing to features in Shackleford's environment.

Shackleford is a narrow barrier island running west to east for about 10½ miles. On the eastern end, under the sweep of Cape Lookout's lighthouse beam, a broad, grassy swale rolls back from the dunes, pocked with holes containing rainwater, until it reaches the salt-marsh flats on the island's sound side. This eastern end is open, easy to patrol. Four herds made their home there, never leaving. Even when stampeded and driven away, the herds quickly re-settled their home turf. On many a stormy night, Rubenstein has watched them huddle together behind a dune or a fishing shack, unwilling to leave

their territory, even for sheltering trees just a few miles away.

Why are the territories so important? Rubenstein believes that, by defending large areas of resources, a stallion can increase the size of his harem, secure better grazing sites for the females in his herd, and help ensure that he fathers more offspring.

Grass grew longer in the territories. Rubenstein has reported that the horses there seemed to discipline their grazing—cropping one area at a time, allowing new grass to establish itself.

But on Shackleford's western end, high dunes and maritime forest break the landscape into clumps of vegetation too small to manage or defend for the sake of a large herd. Here was a kind of netherland of bachelors, outcasts and lone mares, running in small bands, disbanding to form new groups, scuffling over

*Continued on next page*



a drink of water, a mouthful of grass. The weakest and the lowest-ranking drank last and least; many died. Only a few gained the strength and rank to challenge a harem master for his herd, or earned a place on the East End.

Between these regions lies a third, where Rubenstein found both the vegetation and the pattern of equine society in transition. Two herds shared the area, and their habits were like those of the wild mustangs in the Grand Canyon. Their ranges overlapped; they took turns at central watering holes.

"Growing up in animal societies is not an easy task," Rubenstein writes. It is a stark understatement, measured against the sun-bleached bones of a horse that died because it lacked the strength to pull itself out of the marsh mud. On Shackleford, no one intervenes in the process of natural selection. Aside from the July Fourth roundup, when families, many from Harkers island, brand a few foals and reclaim a largely symbolic ownership, people for the most part leave the horses alone. Sickness, injury and starvation trim the population to a hundred or so.

Rubenstein says that newborn colts have a 41 percent chance of living two years, the age by which most are weaned. Fillies face slightly better odds, probably because they are less rowdy and require less food.

Colts and fillies born into this world find it governed by the drive to survive, to leave offspring, but also by aggression and a strict protocol.

Typically, colts stay in their parents' herd until about age four, the age when most are ready to breed. Then they leave, some of their own accord, some because they are at last driven away.

Infrequently, a colt will be strong and smart enough to earn a place as helper in the herd of a neighboring stallion. Most often, he must first pay his dues among the bachelors and loners on the West End. If he arrives there strong and practiced at fighting, he may enter West End society with a rank near the middle, and survive to reproduce, either by taking a harem, or by sneaking into another stallion's herd to mate.

Rank is both a matter of seniority—the older bachelors often prevail—and power. Males win promotions with their teeth, their hooves, and also with the ferocity of their threats.

Fillies, which begin breeding around their third birthday, often leave their natal herd then and wander widely on the island before they settle on a harem, where they are usually welcome by the stallion, if not by the other mares. Rubenstein postulates that these relocations—among both males and females—help reduce inbreeding.

Photo by Neil Caudle



*A Shackleford mare and her foal*

In the harem, a filly is also assigned her rank, depending on her age and condition—adults ranking highest. Threats, headshakes and kicking help the top mares dominate their subordinates.

The top-ranking mares enjoy several privileges, especially in the territories. Rubenstein has shown that territorial stallions favor ranking females, both as mates and for what he calls "grooming." Horses groom one another by picking off bugs with their teeth, or cleaning matted manes and coats. They exercise more independence as well, since the stallion herds and harries them less frequently than those of lower status. Outside the territories, these privileges of rank were far less pronounced.

Since the revolution of '80, things just haven't been the same among the herds of Shackleford. Big Red, who once ruled a herd of 22 and the big territory on the island's eastern tip, lost his harem to an upstart. So did JJ, a stallion with a harem 18-strong. Now the herds are smaller—six or seven each, and the youngsters run the show.

And what about the colt Slash Star? He lost that battle for the sorrel stallion's harem, some eight months after his arrival as apprentice.

And even though the territorial order has fallen, Rubenstein and his students will be back next year, and probably for years to come, watching to see if it rises again. With their stopwatches, recorders, cameras and notebooks, they will record the births, the deaths, the horseplay and the battles. They will feed all their facts into computers and print out the patterns and pecking-orders. In the laboratory of Shackleford, they are learning not only about horses, but about method—techniques that Rubenstein says will help them see how wild creatures of all kinds adapt to a harsh and unusual environment.

—Neil Caudle



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



When it comes to fertilizing the land, it may be best to look to the sea. Hans Paerl, a Sea Grant researcher at the University of North Carolina Institute of Marine Sciences in Morehead City, has found that codium seaweed stimulates growth in plants.

Codium grows thick in shellfish beds, often choking the bed's occupants. Paerl wanted to find a use for the nuisance seaweed, one that would make harvest economically feasible and control the seaweed's abundant growth.

Using agricultural methods in an oceanographic laboratory, Paerl set out to see how codium affected plant growth. Other seaweeds, such as sargassum, had been shown rich in plant hormones that stimulated growth. But tests indicated codium did not produce a high concentration of these hormones.

Trying another approach, Paerl tested codium as a soil conditioner for corn. He found that soil conditioned with codium yielded greater harvests than soil dressed with horse manure.

Paerl says the codium is best when dried, washed of excess salts and then applied during the fall months as a soil applicant.

Paerl says harvesting codium for use as a soil conditioner depends on three things: a willingness by fishermen to harvest the seaweed, the economic benefits of harvest and processing, and the acceptance of codium as a fertilizer in place of more traditional soil dressings such as manure.



Surf fishing, sailing, snorkeling and traveling are just a few of the activities planned for a summer workshop for young people. The 4-H Marine Environment

Workshop will concentrate on marine resources, coastal ecology and marine-related careers. The workshop will include programs at the Bogue Banks Marine Resources Center, the Division of Marine Fisheries and the NCSU Seafood Lab.

The workshop will be held August 7-12 at Mitchell 4-H Camp in Swansboro. Registration is open to teens ages 14-18 and is not limited to 4-H members. The fee for the week-long workshop is \$90 and the deadline for registration is July 1. Participants will be accepted on a first-come, first-serve basis and the workshop is limited to 40 students.

The workshop is one in a series of 4-H activities that have grown out of a Sea Grant project conducted in 1981 and 1982 to promote marine awareness.

For more information, contact Jaynee Medlicott, P.O. Box 5157, North Carolina State University, Raleigh, N.C. 27650 or call (919) 737-3243.



Battery Island, just across the Cape Fear River from Southport, is the site of the largest heronry in the state. And, each spring and summer, at least 4,000 pairs of herons make the island their home.

According to James Parnell, a biologist at UNC-Wilmington who has done Sea Grant research on waterbirds, "Many birds, in the process of nesting and raising their young, damage the habitat. Herons are like this. For example, they produce so much excrement that they actually over-fertilize the vegetation. They also just physically break a lot of it down."

For the past year, one of Parnell's students has studied the birds of Battery Island. He's trying to find ways to maintain the nesting site so the birds will return to the island year after year.

Parnell has received Sea Grant mini-grant funds to survey populations of nesting colonial waterbirds. In an earlier Sea Grant project, Parnell and Robert Soots, an associate investigator, developed a census methodology for calculating waterbird populations. They used the methodology to find out where and how many colonial waterbirds were nesting along the North Carolina coast. Now Parnell wants to check the waterbirds to see if populations and nesting sites have changed.

"Birds are an important barometer of the environment that should be monitored periodically," says Sea Grant Director B.J. Copeland.

Soots and Parnell's *Atlas of Colonial Waterbirds of North Carolina Estuaries*, written at the completion of their project, is available from UNC Sea Grant, Box 5001, Raleigh, N.C. 27650. The 274-page book costs \$7. Ask for publication UNC-SG-78-10.



Larry Crowder, a North Carolina State University zoologist, has received mini-grant funds to study the predator-prey relationship among fishes in the estuary. Crowder, who recently joined the NCSU faculty, comes to North Carolina from Wisconsin, where he has just completed a three-year Wisconsin Sea Grant project.

Crowder will be sampling fish in Pamlico Sound's Rose Bay to establish predator diets and size. He plans to develop a predator-prey model for the area.

*Continued on next page*



Mini-grant funds have been awarded to John Maiolo, an East Carolina University sociologist, to develop a methodology to measure the growth and impact of recreational populations in five coastal counties: Hyde, Dare, Carteret, New Hanover and Brunswick. Information learned from the study will be useful to managers who allocate resources such as water supplies and recreational areas.

Maiolo will also take a hard look at how the housing growth that results from increased tourism affects shellfish closings.

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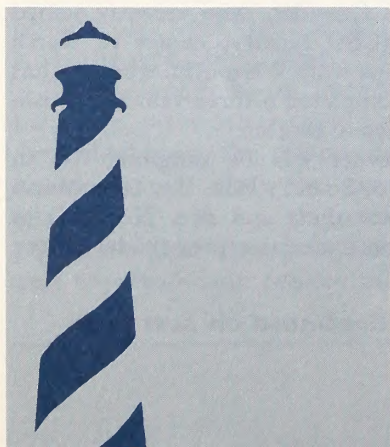
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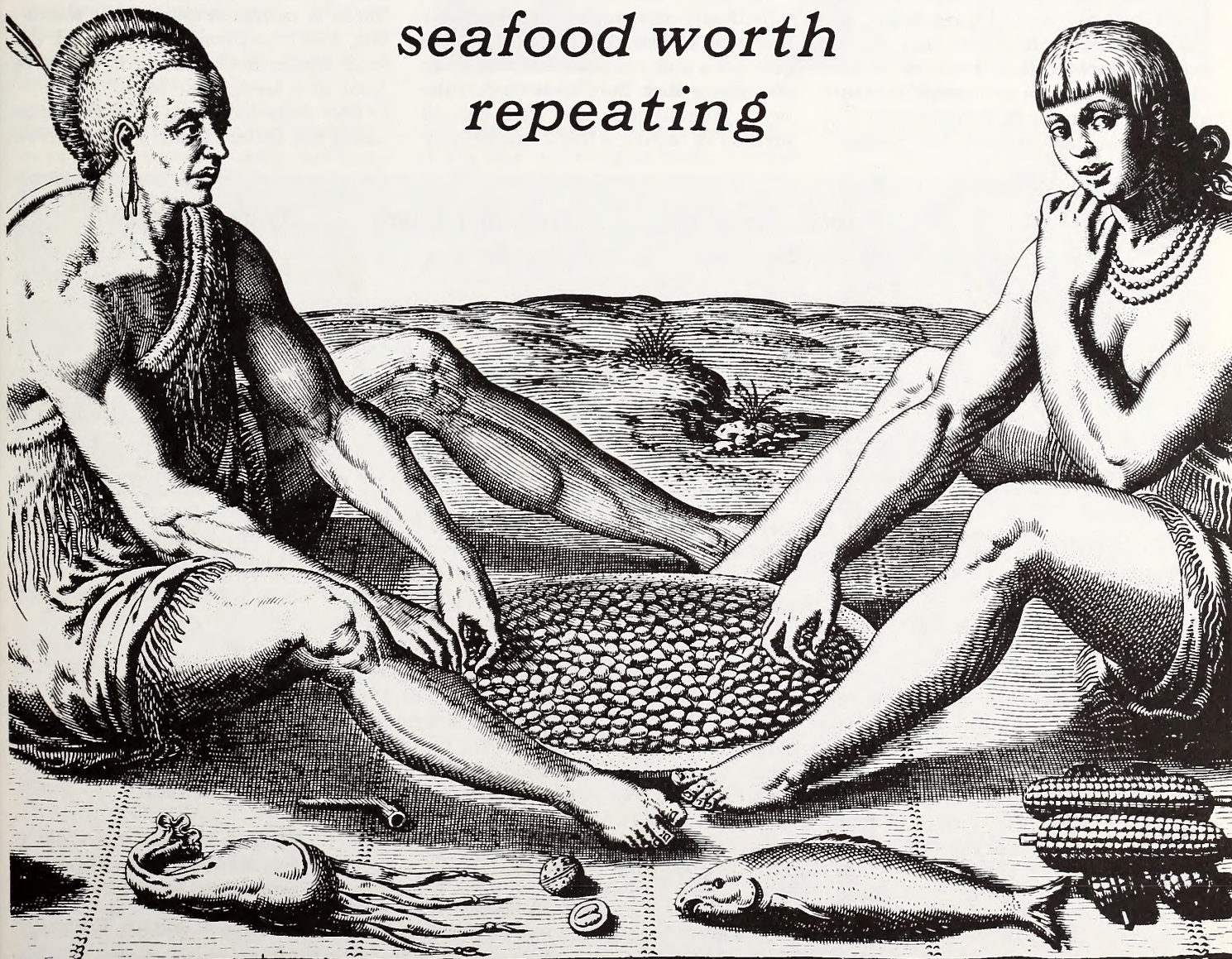


AUG 3 1983

# COAST WATCH

*Go where there's fish in the kitchen all year. Find out how they cooked it in the Indians' days, the settlers' days, the good-ol' days. Hunt up one of those cooks who can stir today's conchs into chowders rich as history. Inside,*

*seafood worth  
repeating*



An old engraving of one of John White's drawings



# For coastal cooks, it's conch chowder and crab stew

In kitchens from Currituck to Calabash, coastal Carolina cooks dish up seafood with a pinch of time-honored tradition. Coastal cooks have been stirring up hard crab stew and downeast clam chowder as long as anyone can remember.

To hear cooks like Eloise Pigott of Gloucester and Nellie Myrtle Pridgen of Nags Head tell it, you'd think there was nothing special about their ways of cooking seafood. They can hardly believe you're asking about their recipes—the recipes that were passed along from a neighbor or relative and are as much a part of coastal tradition as boatbuilding and netmaking.

The recipes for clam chowder and cornmeal dumplings aren't written in fancy cookbooks or touted by gourmets. But that doesn't mean the end result fails the test of good eatin'. It doesn't. Most coastal folks had rather pull up a chair to a bowl of conch chowder or a plate of steamed shrimp than liver pate or beef Wellington.

Most of the recipes for coastal

favorites are stored in the heads of the cooks who prepare them. Each cook has his or her own version of clam chowder, adding a "nickit" more of this or that.

Landlubbers tend to think coastal cooks fry all of their seafood. "Tourists and people from outside the area think all we know how to cook is fried fish, fried cornbread and fried potatoes," says Eloise Pigott, a Gloucester native. "That's a myth. Fried food is good and some things are best fried, but we do know how to cook seafood other ways."

Coastal cooks bake, broil, boil, stew and roast their seafood. And coastal natives like their seafood best if it's as fresh as the day it was pulled from the net.

Marlene Hieronymus, a Wrightsville Beach cook, says to check a fish's freshness by checking the gills. "If the gills are a nice red color and smell like the ocean, then the fish is fresh," she says. Hieronymus says the age-old method of testing a fish's freshness by

the clearness of the eye may not always be accurate. Many times the eye will be damaged in handling the fish, which doesn't mean the fish is not fresh, she says.

Nellie Myrtle Pridgen—Nellie Myrtle to those who know her—is a Nags Head resident and Outer Banks native, who says she cooks seafood the simplest way possible. "My father and brother were fishermen and I learned early on not to destroy the taste of seafood with a lot of batters and seasonings, she says.

Nellie Myrtle says she boils her fish in "a tiny bit of bacon grease and butter." She dresses her clam chowder with tomatoes, potatoes, onion and green peppers. If left with a few small (two to three inches) hard crabs in a catch, Nellie Myrtle cleans them, rolls them in cornmeal and a little seasoning, and fries them. "You can eat the crab whole, shell and all, if you have your own teeth," she says.

Soft crabs have long been a favorite along the Outer Banks, Nellie Myrtle



## Downeast Clam Bake

To a cheesecloth bag, add pieces of cut-up fryer chicken, a carrot, an onion, potatoes (sweet or Irish), an ear of corn and 1/2 dozen (or more) cherry-stone clams. Allow one bag per person. Add water to bottom of a steam cooker. Put tied-off bags in top section of steamer. Cook three hours.

Bill Pigott

## Conch Chowder or Soup

*meat from 7 to 8 conchs*  
*2 to 3 potatoes, diced*  
*1 small onion, sliced or chopped*  
*chopped rib-side pork*  
*pat of butter or margarine*  
*thyme*  
*salt and pepper*  
*1 1/2 quarts of water*

After tenderizing conch in pressure cooker, chop in small pieces. Place chopped conch in pot, add water, pork and butter. Salt and pepper to taste. Simmer two to three hours. Add potatoes and onions 30 minutes before chowder is done. Also, sprinkle with thyme. Add cornmeal dumplings during final 15 minutes.

Bill Pigott

## Downeast Clam Chowder

*1 quart chopped clams*  
*2 quarts water*  
*2 medium onions, chopped*  
*3 to 4 slices salt pork or bacon drippings*  
*6 medium potatoes, cubed*  
*salt and pepper*  
*cornmeal dumplings*

In a large pot, combine first six ingredients. Some Carteret County cooks fry the bacon before adding to chowder; others don't. Still others use bacon drippings. Cook the chowder until the potatoes are tender (approximately 30 minutes). Drop cornmeal dumplings on top of chowder. Cover tightly and simmer for 15 minutes.

Adapted from  
 combination of recipes

## Oyster Fritters

*chopped oysters*  
*(about 1 cup)*  
*1 egg, beaten*  
*flour*  
*salt and pepper*

Mix together chopped oysters, beaten egg and seasonings. Add just enough flour to hold together. Drop by spoonfuls into hot grease. Fry until golden.

Eloise Pigott

## Crabmeat Cakes

*crabmeat*  
*cracker crumbs*  
*dab of mustard*

Mix crabmeat, cracker crumbs and mustard. Shape into cakes. Fry in butter.

Nellie Myrtle Pridgen



says. She remembers when you could buy them for 10 to 25 cents a dozen, unlike the \$10 to \$20 price tag they carry today. "There's only one way to cook soft crabs and that's fried," she says.

Nellie Myrtle is famous for her fish cakes, but she won't divulge her recipe. She does say that when choosing fish for any recipe she always chooses a female fish. "They're shorter, fatter and tenderer," she says.

Seafood prepared in restaurants doesn't fare well by Nellie Myrtle standards. "I'd as soon eat a snake as eat in a restaurant," she says. "I never follow a recipe when I cook. I cook according to what I have and the number of people I'm cooking for."

In Wrightsville Beach, shrimp top the list as everyone's summer seafood favorite. Steamed shrimp are heaped in mounds before hungry crowds in traditional "shrimparoos". Marlene Hieronymus says she steams her shrimp with the heads on. "The heads add flavor," she says.

"You steam the shrimp in a small amount of water until they turn pink," says Hieronymus, who provides seafood recipes and tips once a month on "The Jim Burns Show," which is aired on WECT-TV in Wilmington. "Be careful not to overcook shrimp. They become tough. If you're preparing large quantities for a shrimparoo, be sure to turn the shrimp in the pot so they'll cook evenly."

Hieronymus says she heaps the shrimp in a big bowl on the picnic table and lets everyone dig in. To eat the shrimp, guests pop off the heads and peel the shell away.

Hieronymus serves lots of whipped butter, lemon juice and cocktail sauce for dipping the shrimp. And as side dishes, she prepares roasted corn in the husk, hush puppies and lemonade.

In Carteret County folks eat their seafood "downeast" style with cornmeal dumplings and gravy. Audrey Fulcher, who has cooked at Captain Bill's Seafood restaurant in Morehead City for twenty years, says conch chowder is a Carteret County classic. There's even a saying that goes along with this dish, Fulcher says. "If you ever eat conch chowder in Carteret County, you never leave." The conch, which is more accurately a whelk, has a strong flavor that some say is an acquired taste.

Fulcher says Captain Bill's serves

Photo by Neil Caudle



Albert Cowan and Audrey Fulcher in the kitchen

Photo by Hilda Livingstone

up conch chowder every Wednesday for a loyal following of locals. Fulcher won't reveal the exact recipe for the chowder, but she says the ingredients are ground conch, water, potatoes, onion, meat grease, salt, pepper and cornmeal dumplings.

Head cook Albert Cowan, who has spent 21 years in the kitchens of Captain Bill's, adds another ingredient to the conch chowder—Worcestershire sauce. Cowan says the conch chowder recipe is his own, derived by varying the ingredients until just the right taste was achieved. Cowan smiles and politely refuses to give out his recipe. After all, he wants to have plenty of customers on conch chowder day when he stirs up about 20 gallons of this Carteret County favorite.

Bill Pigott, Eloise's husband, says making conch chowder requires some extra effort, but the results are worth it. First you should freeze the conch. Bill says freezing the mollusks makes the meat easier to pull from the shells when they're thawed. Once you've removed the meat, keep only the cream-colored foot. Brush away the black coating with a brush, Bill says. To tenderize the meat, either pound it or place it in a pressure cooker. Once tenderized, the conch is ready for the pot (see recipe, page 2).

Using similar ingredients, Carteret



Nellie Myrtle Pridgen

County cooks also prepare a water-based "downeast" clam chowder. "We use no tomatoes and no milk," says Eloise. The chowder is flavored with bacon grease or pieces of bacon, potatoes, onions, salt and pepper. The chowder broth or gravy does turn milky as it cooks, but Eloise emphasizes that no milk is added.

The aroma of hard crab stew, another traditional coastal offering, frequently fills Carteret County kitchens when blue crabs are in season. Eloise says she leaves the hard crabs whole, removing only the hard back shell before cleaning the crustaceans.

Continued on next page



She cooks her potatoes and onions until soft, and salts and peppers the crabs. The ingredients are layered in the pot, adding the onions and potatoes first and placing the crabs on top, Eloise says. She adds water, seasoned with crab boil, to make the gravy. After cooking the crab stew on high heat for five to ten minutes, Eloise turns the heat to simmer before adding her cornmeal dumplings.

A stew, chowder or soup just isn't complete in Carteret County unless you add traditional cornmeal dumplings to the gravy. Eloise says she makes her dumplings out of cornmeal, salt and just enough water to hold the dumpling together. "I shape the dumplings into patties or cakes with my hands," she says. "Then I drop them into my stew or chowder to simmer for about 15 minutes.

"We put cornmeal dumplings in clam chowder, conch soup and collards. We put them in everything we boil. They used to say Carteret County cooks put dumplings in the clothes they washed back when clothes were boiled before washing machines were common."

The Pigotts continue another time-honored coastal practice—corning fish in salt brine for preservation. When the spot start running in the fall, the Pigotts begin their brining process by keeping the fish they catch in an ice-water bath. The spot are cleaned, but not scaled. The fish are first put in a

light brine solution and stored in the refrigerator for a few days, Eloise says. Then the spot are washed and placed in heavy brine in large containers.

When her family has a hankering for fish, Eloise removes the salty spot from their storage containers with a wooden spatula. Never use metal in the brine, she says. Eloise soaks the fish in water, changing it often, to remove some of the salt. Then she may boil the spot for breakfast or dinner. If preparing the fish for dinner, Eloise also boils some potatoes and onions. The spot is mashed in with the potatoes and onions on the plate and hot pepper vinegar sprinkled over the fare.

Eloise says they store the fish from season to season. "We enjoy the fish we brine," she says. "It gives us the advantage of having fish in the winter when you can't get fresh seafood."

Fish roe, the eggs found in the tubular, saclike ovaries of female fish such as mullet, menhaden, croaker and herring, are coastal Carolina's answer to caviar. The roe can be fried, baked or scrambled with eggs. To preserve the roe for year-round use, it can be dried or frozen. Eloise uses the old-timey method of drying mullet roe in the sun for a few days, turning them periodically. Mullet roe give off a strong, pungent aroma as they dry. The flavor of roe varies from species to species. "Roe are like olives, either you like them or you don't," says Eloise.

Photo by Neil Caudle



Eloise Pigott

When a gathering is called for, coastal families don't hesitate to center the gathering on food, particularly seafood. Oyster roasts, fish fries, shrimparoos and clam bakes make a good excuse for seeing friends, gathering the church members or just plain having fun (see clam bake recipe, page 2).

But whether it's a large gathering or just family, coastal cooks like Nellie Myrtle and Eloise continue to use the recipes that they know have been tried and proven for generations.

—Kathy Hart

## Before the fish stick and Captain's Platter . . .



Boiled skate, baked turtle and roasted eel. Not the most popular menu by today's standards. But in the 18th century, such dishes were regular fare. Folks then weren't so squeamish about what they ate. While many dishes could just as well turn up on a seafood restaurant's menu today, others, such as the fish muddle, the pine bark stew and the eel stiffler, might make some of us turn up our noses. Not because they're not good, mind you. They're just unfamiliar.

The old dishes had both flavor and variety, says Joyce Taylor, Sea Grant's marine advisory agent at the North Carolina State University Seafood Lab in Morehead City. This summer, Taylor has been researching and testing colonial recipes with her

team of nutrition leaders from Extension Homemakers Clubs in Carteret County. The dishes they prepared got high marks, and so did their lesson in history.

Taylor says our colonial ancestors ate a wider variety of seafood and depended on it more than we do today. Seafoods were the one thing they could count on when other food supplies ran low. In 1588, Thomas Harriot wrote in "A briefe and true report of the new found land of Virginia" that the colonists were eating sturgeon, herring, trout, porpoise, ray, menhaden, mullet and flounder as well as many fish that he couldn't name. Crabs, oysters, scallops, periwinkles and turtles also were a part of the settlers' diets, he says.



Back then, cooks knew how to do more with a fish than just fry it. In her research of colonial cooking, Taylor found references to roasting, boiling, broiling and stewing seafoods. "We found many of the recipes were quite simple, but a few were very elegant, like one for baked fish with stuffed clams," says Taylor (see recipe next page).

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*"We found many of the recipes were quite simple, but a few were very elegant."*  
—Joyce Taylor

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Those were the days when recipes were handed down, generation to generation. Only one cookbook, *The Frugal Colonial Housewife*, was published in America between 1742 and 1796. That book instructed housewives in "the art of dressing all sorts of viands with cleanliness, decency and elegance." The way to boil a skate, it says, is to cut it into long strings, throw it into salt and water, and boil it for three minutes. Drain it well and serve on a platter, surrounded by broiled eel, with a butter and mustard sauce.

Eel, considered an underused species in this country today, was a frequent colonial dish. It seems the settlers, accustomed to dining on eel in Europe, brought a wide variety of recipes with them to the new country. *The Frugal Colonial Housewife* instructs cooks to prepare eel by roasting, boiling, frying, broiling and stewing. And, of course, no colonial housewife should be without a recipe for eel soup and eel pie.

A favorite recipe, published in an 1832 magazine, was the eel stifle, a combination of onions, port wine, gravy, vinegar, anchovies and spices, boiled with eel.

One of the most popular North Carolina dishes was a muddle, named so because it was a stew of fish muddled together with pork, bread crumbs, onions, mashed potatoes and spices. Potatoes, a common ingredient in colonial recipes, were often mashed, then added to a stew as a thickener (see recipe next page).

Another Carolina original was the pine bark stew. During Revolutionary War times, Carolina cooks concocted the fish stew using the tender roots of

pine trees for flavoring, along with a slab of bacon and a red pepper pod (see recipe next page).

The North Carolina tradition of seafood didn't start with the English settlers. The seafoods we eat and the way we prepare them date back to the Indians. Legend has it that the first settlers to land on the North Carolina coast were greeted by Indians, bearing

the gift of a boatload of freshly caught fish. Those native Americans didn't record their recipes, but they did leave behind something almost as valuable—garbage.

David Phelps, an archaeologist at East Carolina University, rummages through ancient Indian garbage pits, called middens, in search of clues that will tell him how the Indians lived. A list of the remains in those garbage piles reads like an Indian menu: shellfish, opossum, terrapin, fish, bear and deer.

"People have to put their garbage somewhere and the middens are where all the food remains and old utensils went. We can go back a couple of thousand years by exploring those garbage piles," says Phelps. He's found that for the most part, the Indians were eating the same things we're eating today. (Unlike the colonists, however, there is no evidence that Indians ate eel.)

"Unfortunately, we tend to think of the Indians as savages living on the

verge of starvation," says Phelps. On the contrary, those native Americans had a well-developed agricultural system, producing such crops as corn, beans, peas, pumpkin, melons, potatoes, squash, cucumbers, tomatoes, onions, and herbs and spices. Some of the crops, they stored for the winter. When the stores went down, usually in the spring, they depended on hunting and fishing to sustain them.

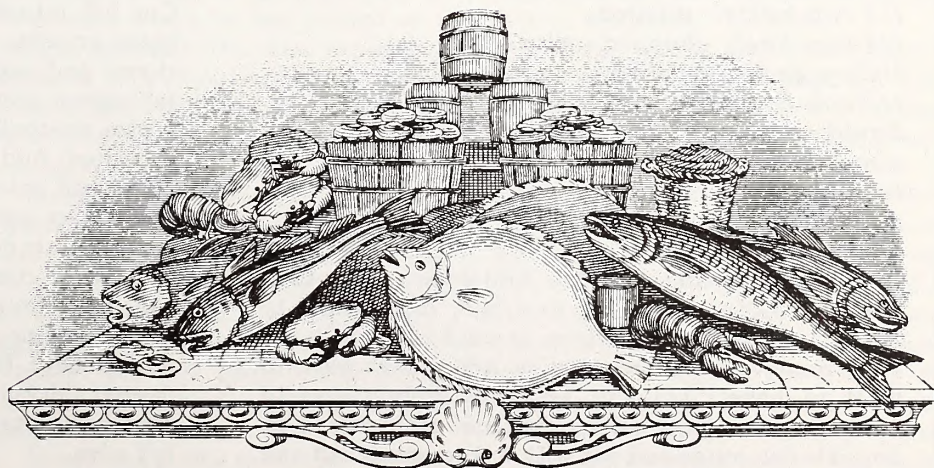
Excavations on Collington Island, on North Carolina's Outer Banks, turned up evidence that 2,000 years ago, the Algonkian Indians established fishing camps there when food was scarce elsewhere. Phelps says, "The Algonkian people knew how to get every ounce of food out of the estuarine system."

We have to speculate on how the Indians cooked their seafood, says Phelps. But John White, a colonial historian and artist, left paintings, showing that stewing and broiling were at least two of the methods.

What we eat today is a blend of the European tradition and the Indian know-how. Oyster roasts and clam bakes date back to the earliest colonial days, probably because the Indians showed the settlers how to dig a hole in the ground, line it with hot stones, and cook seafoods in the covered pit.

Joyce Taylor says her research has shown her that modern cooks can take a few tips from their colonial counterparts. The recipes may be a few hundred years old, but they've stood the test of taste. And those skates, eels and oysters—well, they're just like the ones the colonists used. Good as ever.

—Nancy Davis



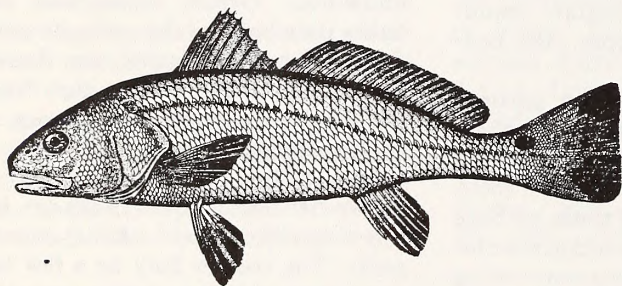


## Pine Bark Stew

*2 1/2 pounds trout fillets or other fish (you may use 2 species)*  
*4 bacon strips*  
*1 cup chopped onions*  
*1 1/2 cups diced potatoes*  
*1 quart boiling water*  
*2 teaspoons salt*  
*1/2 teaspoon dried thyme*  
*1/2 teaspoon dried marjoram*  
*2-inch piece of dried red pepper pod*  
*4 or 5 small tomatoes, peeled, or equivalent canned*

Cut bacon into squares and sauté over very low heat until lightly browned. Drain off all but about 3 tablespoons fat. Stir in onions and cook for about 5 minutes. Stir in potatoes, cover with boiling water, and season with salt, herbs and dried pepper pod. Simmer until potatoes are partly done, about 10 minutes. Add whole fish and continue to simmer for 10 minutes. Add tomatoes and cook for 5 to 10 minutes or more, until fish flakes easily and potatoes are tender. Remove pepper pod before serving. Serves 6-8.

Note: The modern version of this stew eliminates the original pine flavoring.



## Baked Fish with Stuffed Clams

*20 littleneck clams, scrubbed in the shell*  
*1 whole fish (about 3 pounds), cleaned*  
*1/2 teaspoon salt, divided*  
*1/8 teaspoon pepper, divided*  
*1/2 cup butter, divided*  
*1/2 cup finely chopped onions*  
*1 clove garlic, crushed*  
*1/3 cup fine dry bread crumbs*  
*3 tablespoons minced parsley*  
*almondine sauce*  
*lemon slices*  
*parsley sprigs*

Place clams in a large saucepan. Add water to a depth of 3/4 inch. Cover and bring to a boil; reduce heat to medium. Cook 5 to 7 minutes, or until clam shells are open. Remove clams and set aside. Add enough water to broth to make 1 1/3 cups; set aside. Preheat oven to 375°. Grease a large baking dish and place fish in it. Sprinkle fish inside and out with 1/4 teaspoon salt and

part of the pepper. Dot with 1/4 cup butter. Pour 1 cup of the clam broth into baking dish. Bake fish 20 minutes. Meanwhile, remove clams from shells. Reserve 18 half shells; place in a shallow baking pan. Chop clams finely. Sauté onion and garlic in remaining butter. Add clams, bread crumbs, parsley and remaining salt and pepper and mix well. Add enough broth to moisten. Spoon mixture into reserved half shells. When fish has baked 20 minutes, place pan of stuffed clams in oven. Bake fish and clams 25 minutes, or until done, basting fish occasionally with liquid from bottom of pan. Fish is done when it flakes easily with a fork. Transfer fish to a warm serving platter. Pour on almondine sauce. Surround with hot stuffed clams. Garnish with lemon and parsley. Makes 6 servings.

## Almondine Sauce

Melt 1/4 cup butter in a skillet over medium heat. Add 1/3 cup sliced almonds. Sauté, stirring, until almonds are golden.

(Adapted from *The Early American Cookbook* by Hyla O'Connor. Copyright 1974 by Alan Landsburg Productions, Inc. Published by Prentice-Hall, Inc.)

## Fish Muddle

*1 pound fillets*  
*1 pound ground pork sausage*  
*1 1/2 cups fresh bread crumbs*  
*1/2 cup minced onion*  
*1 egg, beaten*  
*1 teaspoon marjoram leaves*  
*1/4 teaspoon leaf thyme*  
*1/8 teaspoon pepper*  
*1 to 2 tablespoons cooking oil, optional*  
*1/2 cup minced onion*  
*1 cup water*  
*4 cups half and half*  
*1 1/2 teaspoons salt*  
*2 cups or more of mashed potatoes*  
*chopped parsley*  
*chopped hard-cooked egg*

Cut fish into serving size portions. Combine sausage, bread crumbs, 1/2 cup minced onion, egg, marjoram, thyme and pepper. Shape into balls using about one tablespoon mixture per ball. In a 5-quart Dutch oven brown meatballs adding 1 to 2 tablespoons cooking oil, if desired. Add 1/2 cup minced onion and continue to cook until onion is tender. Add water and bring to a boil. Cover and simmer for 10 to 15 minutes or until meatballs are done. Place fish fillets on top of meatballs. Combine 2 cups of half and half with salt. Pour over fish. Heat until fish flakes easily when tested with a fork. Combine remainder of half and half with potatoes until smooth. Heat for 2 to 3 minutes or until mixture is desired thickness. Stir in chopped parsley. Ladle into soup bowls; sprinkle with hard-cooked egg. Makes 11 1/2 cups.



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



It's shrimp season and no fisherman likes to find a drowning sea turtle in his shrimp trawl. He knows he loses shrimp and money every time a turtle gets tangled in his net. Trawling efficiency devices (TEDs) may offer help to fisherman and to turtles. Early evidence indicates that the devices, sewed into trawling gear, can fence the turtles and other large sea animals out. They may save lives of turtles, some of which are endangered, and allow for longer tows by trawlers.

Larry Giardina, a Sea Grant marine advisory agent at Bogue Banks, is offering five TEDs for fishermen to try out on their boats. There will be no charge for a device and Giardina will explain its use. If you're interested, contact Giardina at the Bogue Banks Marine Resources Center, P. O. Box 896, Atlantic Beach, North Carolina 28512 or call 247-4007.



For years, commercial fishermen have been catching flounder in their crab pots. That gave Etles Henries an idea. He's built a pot just for catching flounder. Henries, a Blounts Creek businessman, designed his flounder pot to be flatter and with a wider entrance tunnel than the crab pot, he says.

Henries says there's just one snag in his invention. So far, he's been unable to find a suitable bait to entice the fish into the pot. He says there's an ample supply of small fish in the sound for

the flounder to feed on, so they don't need to go into the trap for food.

This summer, Bob Hines, a Sea Grant marine agent at Bogue Banks, will be testing baits for use in the flounder pots. Henries says, "We're looking for a curiosity bait, something that will bring the flounder into the pot because he's curious about it." One possibility is a battery-powered light, placed in the pot, to draw the attention of the fish.

If he is able to find a bait the flounder like, Henries says he'll be able to sell his pots for \$8. He says a fisherman will be able to run a line of flounder pots as economically as he can set out a line of crab pots.

But Henries adds that he won't put his design on the market until he can advise fishermen on what bait to use. We'll let you know how the testing turns out.



Sea Grant has a new area specialist in the Manteo office. Rich Novak will be developing an educational program that will help recreational businesses

at the coast improve their management. He'll also work with the tourism industry in analyzing the recreational needs of coastal counties and cities.

Novak comes from the Recreation Resources Center at the University of Wisconsin where he has worked as a project assistant. His other experience includes consulting for private recreational developments, teaching at the University of Wisconsin and managing recreation facilities.

Novak has a bachelor of science in Recreation and Park Administration and Business Administration from Western Illinois University, a master of science in Forest and Range Management from Washington State University, and has done post-graduate work at the University of Wisconsin in Madison.

If you would like to contact Novak, write him at the Marine Resources

Center, Roanoke Island, P. O. Box 699, Manteo, North Carolina 27954 or call (919) 473-3937 or 5441.

Had trouble getting a call through to Bob Hines or Larry Giardina, the marine advisory agents at Bogue Banks? The problem is not in your dialing. The telephone number for the Marine Advisory Services office has changed. The new number is (919) 247-4007.

But the agents have not moved. They can still be found at the Bogue Banks Marine Resources Center.



It was a rough year for homeowners with beachfront and soundfront property. Spencer Rogers, Sea Grant's coastal engineering specialist, says that an average of 15 to 20 oceanfront houses are

threatened each year. But this year, about 150 were threatened. (A house is threatened if there is no substantial protection between it and the shoreline.) At Topsail Beach, one of the areas hardest-hit, over 60 houses were threatened.

Rogers blames the high frequency of northeasters, which repeatedly pounded the coast this winter, and the increased erosion in areas of high density. "I saw more erosion of dunes this year than has been typical in the last five to ten years," he says.

Damage wasn't confined to oceanfront property, says Rogers. "The sounds and rivers also took a beating with the worst damage on the Neuse River."

Sea Grant offers a series of five colorful 23" x 35" posters depicting erosion in four of the state's major estuaries: Core/Bogue Sounds, Albemarle Sound, Pamlico River and Neuse River. The fifth poster, "Cause and Effect," explains the reasons for estuarine erosion. For a copy of the free posters, write UNC Sea Grant. Please specify which posters you want.

*Continued on next page*



Spencer Rogers, was chosen by the Sea Grant staff as Agent/Specialist of the Year. Jim Murray, director of advisory services, says Rogers received the award for outstanding development and implementation of his extension program. Rogers developed programs that helped coastal communities solve shoreline engineering problems.



**UNC Sea Grant** Director B.J. Copeland says he would like to see more North Carolina researchers involved in developing the nation's ocean policy. Ocean policy involves studying the international use of our oceans and the questions of territorial rights.

Copeland has provided project initiation funds for a new North Carolina Marine Policy Fellowship Program that will be administered through the Institute for Coastal and Marine Resources at East Carolina University (ECU). The first fellowship will be awarded to a student in the ECU Department of Sociology, Anthropology and Economics under the direction of Michael Orbach, a noted ocean policy researcher.

The fellowship program will train top students in marine policy, providing leaders that will help solve tomorrow's ocean-use problems.

To keep abreast of the latest in estuarine research, the National Oceanic and Atmospheric Administration (NOAA) sponsored a national three-

day conference at the University of Delaware at Newark, June 21-23. Component members of NOAA, such as the Sea Grant Program and the National Marine Fisheries Service, provided updates on their estuarine research efforts.

B.J. Copeland, UNC Sea Grant director, moderated a session on the problems facing estuaries in the United States and the Sea Grant research being funded to combat those problems.

The conference will be followed with a National Estuarine Symposium that will be held in Raleigh next year.



Frank Thomas, of the NCSU Department of Food Science, and Sam Thomas, a Sea Grant Seafood specialist, have revised the *Technical Operations Manual for the Blue Crab Industry*. The manual is designed to help processors produce high quality crab meat. This second edition reflects regulatory changes in blue crab processing since the original edition was published. For a copy, send \$1.50 to UNC Sea Grant, Box 5001, Raleigh, N.C. 27650. Ask for UNC-SG-83-02.

It's that time of year again—hurricane season. And this just may be the year when another Hazel comes to call. Are you prepared?

Send for the new brochure, *About Hurricanes, what to do and when to leave*. The brochure tells you what to expect when a hurricane strikes, how to plan ahead, what to do if one is

forecast, and what to do after the storm has passed. The brochure also provides a large tracking map that can be used to follow the progress of this season's hurricanes.

The brochure was published by Sea Grant, the N.C. Division of Emergency Management and the N.C. Office of Coastal Management. John Sanders, Sea Grant's former coastal weather awareness specialist, acted as an advisor for the project.

For a free copy of the colorful brochure, write Sea Grant. Ask for *About Hurricanes*.

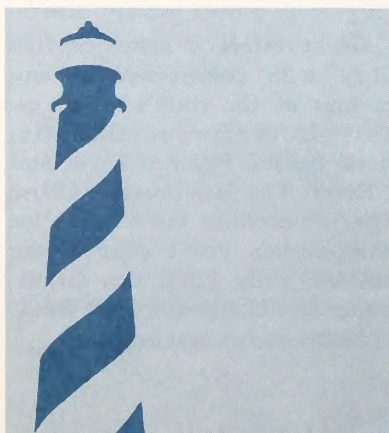
*Hurricane Emergency Planning: Estimating Evacuation Times for Non-Metropolitan Coastal Communities*, by John Stone of the NCSU Department of Civil Engineering, is written to give emergency planners in coastal communities simplified methods for estimating hurricane evacuation times. For a copy of the publication, send \$1.50 to UNC Sea Grant. Ask for UNC-SG-WP-83-2.

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# COAST WATCH

Drawing by Anne Marshall Runyon



## Rose Bay, on a warm September night

Along the shore, juncus and cordgrass bristle under the electric hum of insects.

John Miller crawls out of a tent he's pitched on a stretch of high ground, stands, and glances down to watch a pink pygmy rattlesnake slide over the arch of his foot. Sometimes, a pygmy will forget to strike. This is one such time.

Miller seizes the rattler, drops it into a box for the herpetologists back at school. It tries to

*Continued on next page*



strike. Nothing he collects at Rose Bay goes obediently into a box. Not the snakes; not the data.

He is here among the mosquitoes and pygmy rattlers because this place, Rose Bay, harbors life. It nurses things with fins, scales, warts and wings. It shapes them, breeds them, multiplies them all. This is where the oysters seem to fatten overnight, bewitched. Over by Judith Island, at the mouth of Rose Bay, there's a spot called Drum Point. A sporting magazine has called it the best red-drum fishing hole in the country.

But Rose Bay keeps its riches under wraps.

"If you're just driving by on highway two-sixty-four, all you'll see is an expanse of ordinary marsh grass," Miller says. "You don't see a nursery ground. You don't see one of the most productive estuaries in the state. But when you set a crab pot, or pull a fine-mesh trawl and find ten baby fish for every square yard of bottom, then you see it."

Rose Bay is a wedge-shaped notch of more than 9000 acres in the western shore of Pamlico Sound. Its tributary creeks drain a broad swatch of forest and farms, and much of Lake Mattamuskeet. The water is governed more by wind than by the moon. Lunar tides distend the bay a mere two inches, maybe three. Breezes race into the funnel, squeezed between converging shorelines, piling water into three-foot wind tides.

The bay is mostly wild. It doesn't smell like roses. Its muds have the sulfurous odor of anaerobic decay. No one yet has made Rose Bay a garden spot. There is one marina. Two tiny towns nearby. Out on the bay, commercial fishing boats heave crabs and oysters out of water that is rough, opaque, secretive.

There are fewer secrets here since Miller and

his students came. They asked this place, "What makes a nursery a nursery?" And it began to tell them parts of what they asked. About food chains, energy, overlapping habitats. They asked what happens to that nursery when it takes on sudden gluts of rainwater runoff, carried by a man-made ditch. It showed them abrupt swings in salinity, interrupted cycles, young shrimp dying.

"It turned out to be a better place for our study than we imagined," Miller says. "In many ways it's a typical nursery ground. But it has a wider variety of sub-habitats, or habitat types, than most bays do. And that's important if you're trying to get a handle on nursery grounds in general."

The search for answers at Rose Bay goes on. We need to know exactly what qualities make an estuary a "nursery." It is a label we've assigned largely by observation and intuition, without reliable numbers and measures. North Carolina may be able to keep her estuarine nurseries in business, despite the drainage ditches, the development, the overload of waste and nutrients floating down from far upstream. But it will take good, defensible definitions. It will take a better understanding of just how much of man's intrusion a nursery ground can stand.

Of course there are more characters in this story than scientists and the pink pygmy rattler. Fishermen make a living in a place like this. Boaters unwind with a rod and reel. And more and more, people build and live nearby. They won't be written out of the script. And understanding an estuary means understanding not only the resource, but those who use it.

— Neil Caudle

(John Miller is an associate professor of Zoology at North Carolina State University)



Photo by Mike Dunn



Photo by Scott Taylor



## Estuaries

Estuary. It's one of those scientific terms that is gradually creeping into our common language. You hear a news reporter use it on the air. You see it printed in *National Geographic*. But it's a word just on the verge of becoming common, and there is confusion about what it means.

Fishermen don't bother with the word at all. It's a word they say dit-dots (scientists, in down-east lingo) use. To fishermen, the estuary is Rose Bay, South Creek, Bogue Sound, the Neuse River, places where the fishing is good.

Well then, what is an estuary? It's a place where the salt water and fresh water mix it up. But there's more to it than that. There are fish, marsh grass, circulation patterns, nursery grounds and more. Things that make the estuary special.

We asked six Sea Grant scientists—B.J. Copeland, John Miller, Charles Peterson, Hans Paerl, Stan Riggs and Scott Snyder—to tell us a few things that make the estuary different; to tell us a few things that make the estuary interesting to them. They put together some facts and added up some figures. Here's what we learned:

Over 5,874,000 North Carolinians own Rose Bay. You may not be able to have it surveyed, staked off and fenced in, but you do own a small parcel of that submerged land.

Just as you own part of all the state's estuarine system. We all have a stake in the state's approximately 2.3 million acres of estuaries because they're in the public domain. It's like owning part of your own farm at the sea.

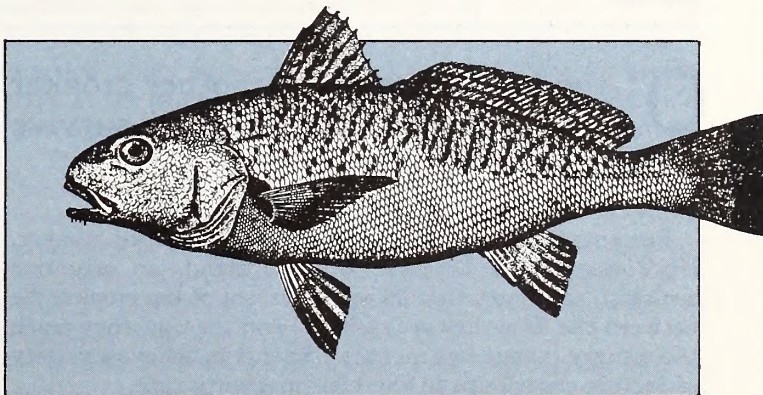
And, North Carolinians hold the deed to more estuarine land than people in most other states. We have the largest estuarine system on the East Coast and the third largest system in the United States. Only Louisiana and Alaska have larger estuarine systems.

Biologists believe 90 percent of the state's commercially important species spend at least part of their lives in the estuary. For example, in 1982 the state's fishermen received \$16.4 million for their shrimp catches, \$7.4 million for blue crabs and \$5.8 million for menhaden. The estuary serves as a nursery for each of those species and many fishermen owe their livelihoods to that estuarine nursery.

## The mother croaker lays 100,000 eggs.

The mother croaker has just cast 100,000 eggs into the western edge of the warm Gulf stream on a cold December day. Now it's up to the warm waters to incubate the eggs until they hatch the one- to two-millimeter larvae several days later.

The ocean isn't a very hospitable home for the newborn croaker. But there is a place that specializes in nursing baby fish, finfish and shellfish—the estuarine nursery. John Miller is intrigued by the life cycle of commercially important species like croaker. And he believes the months spent in the estuary may be critical to the species' survival and maintenance. After all, the larval croaker wouldn't travel



100 miles to places like Rose Bay unless there was something to be gained there, Miller says.

The mother croaker has set her offspring on a time schedule that puts them at all the right places at all the

*Continued on next page*



right times. And this sense of timing may be one of the reasons why croaker are so abundant. Croaker, along with spot, menhaden, and two species of flounder, follow a similar time schedule for spawning, transport back to the coast and arrival in the estuary. These five species make up 85 percent of the state's commercial catch by weight.

Unable to swim, the larval croaker hitch a ride westward on the ocean express. Miller and other scientists believe the larvae ride an intermediate layer of warm ocean water that flows shoreward during the winter. If croaker spawned any other time of the year, their ride to the estuary might not be available.

About January, millions of baby croakers bombard the coastline in search of an inlet to the estuary. Once in areas like Pamlico Sound, the larvae settle to the bottom for another ride to the nursery. Winter winds blow surface waters against the barrier islands. Gravity pulls bottom waters in the opposite direction. By settling to the bottom, the larvae are driven westward into nursery areas like Rose Bay.

Again, time is on the side of the croaker. The larval croaker settle into the nursery between February and May, just in time to catch the estuary's peak productivity during the late spring.

"The croaker grow like crazy in this environment," Miller says. The larval croaker quickly become juveniles, growing from 25 millimeters to five inches during their five-month stay. The juveniles eat clam siphons, copepods, benthic worms and mysid shrimp.

And the estuarine nursery seems to provide some protection from predators. Miller has learned the nursery can be an inhospitable place for adult fish who might prey on juvenile croakers. Temperatures and salinity levels fluctuate. As long as the fluctuations aren't too drastic, young fishes, such as the croaker, can withstand the changes. But adult fish aren't as tolerant of environmental stresses, Miller says. Adult fish tend to avoid the nursery areas, choosing deeper waters.

After completing their growth spurt, juvenile croaker leave the nursery behind about August, graduating to the deeper waters of the estuary or the nearshore ocean waters beyond.

**O**f the 100,000 eggs the mother croaker spawns, odds are, only one will survive to become an adult.

Percentages aren't on the side of the newborn croaker. UNC Sea Grant Director B.J. Copeland, an estuarine ecologist, estimates that 98 to 99 percent of the croaker die between the time they are spawned and the time they reach the estuary (about two months). Scientists believe a variety of factors contribute to the high mortality rate.

As eggs and young larvae, the baby croaker float among the plankton, becoming prime targets for hungry fish. Many die from natural causes—genetic deficiencies, deformities. Others die from environmental stresses. Some never find the right currents to carry them shoreward. And the croaker are so tiny, scientists have a hard time tracking

them through their early days to learn exactly what happens to the baby croaker.

The estuarine nursery offers the baby croaker a better chance. In Rose Bay, three percent of each day's remaining balance of croaker die, says John Miller. Again, factors like predation and environmental stresses such as salinity and temperature changes contribute to the croaker's demise.

But for the croaker who survives to leave the nursery, the odds are favorable. The croaker, now about five inches long, has fewer predators and has moved to the deeper, more stable waters.



**N**early 17,000 years ago, stone-age fishermen would have been living in their villages at the outer continental shelf edge, about 25 miles east of Cape Hatteras.

When the last major ice age began about 35,000 years ago, the North Carolina coastal and estuarine system would have been in a geographic position similar to today. But, it didn't stay there, says Sea Grant researcher Stan Riggs.

Within 17,000 years, glacial ice extended into the northern United States and sea level had dropped about 400 feet. Riggs says the entire North Carolina continental shelf would have been exposed and the estuarine system would have been near the edge of the shelf.

Thousands of years later, the climate warmed again, sea levels rose and waters flooded the river basins, forming today's estuaries.

Such warming and cooling trends take thousands of years, says Sea Grant researcher Scott Snyder. Right now, the earth is in a warming trend, he says.

If that trend were to continue and all the glacial ice in Greenland and Antarctica were to melt, the world's shorelines would eventually be about 200 feet higher than they are now, says Riggs. "This would put the entire coastal plain of North Carolina under water with the shoreline occurring approximately along Interstate 95 between Roanoke Rapids and Fayetteville."

But coastal residents don't have to pack up and move yet, says Snyder. He says most geologists estimate that sea level is rising a half a foot per century. So, we can expect the estuaries to stay put for a while.





*Understanding the estuary also means understanding the people who use it*

**A** molecule of one nutrient may stay in the estuary for years.

Perhaps a molecule of nitrogen arrives in the estuary. There, it finds itself taken up by marsh grass, or maybe by algae or seaweed. When the grass dies, the nitrogen is released and deposits itself in the sediments where it's covered up by more sediment.

Months may go by before something, perhaps a shrimp, disturbs the sediments, sending the molecule back into the water column. Then the process begins all over again.

Estuaries are nutrient traps, says Sea Grant researcher Hans Paerl. "There is a net loss but it can be years before nutrients are released from the estuary."

The sediments in an estuary tend to adsorb (the nutrients attach to the sediments) nutrients and the circulation patterns of the estuary make it easy for them to stay there. A

particle might be carried toward the sea by the freshwater flow at the surface and then returned upstream by the tidal currents below, says Sea Grant researcher Charles Peterson.

That explains why estuaries have a much higher concentration of nutrients than the sea or than the fresh waters draining into the estuaries, says Peterson. Nutrients stimulate plant growth, resulting in the high productivity for the estuary. According to some estimates, an acre of a North Carolina estuary is more productive than an acre of farmland producing rice, corn or hay.

A farmer may work year after year, cultivating, fertilizing and irrigating his soil. Without all the nurturing, the nutrients would eventually be used up. Not so with an estuary. Paerl says the continuous inflow of fresh water provides the estuary with all the nutrients it needs.

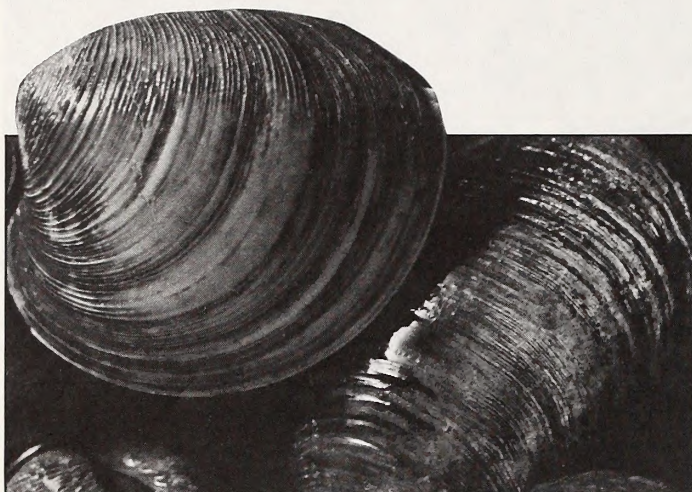
"Most of those nutrients come from the freshwater en-

*Continued on next page*



vironment and the estuary's fertility is due to that freshwater system. But there's a fine line between an adequate amount of nutrients and an excess," says Paerl. An excess of nutrients can cause undesirable levels of algal growth.

Photo by Steve Wilson



## North Carolina's Pamlico Sound is one of the most productive estuaries in the world.

If Pamlico Sound were a bank, it would have one of the richest stockpiles of assets in the world. But the assets in Pamlico Sound are measured in terms of pounds of fish, bushels of shellfish and acres of marsh grass. The dividends from the production of fish and shellfish are easy to calculate. But dividends also accrue from more obscure things like benthic worms, seagrass beds, phytoplankton and bacteria. They are all part of a simple, but lucrative food chain that adds up to a system rich in productivity.

Sea Grant researcher Charles Peterson wanted to compare productivity in two different estuarine systems to see how they stacked up. He chose a creature common to both systems—the clam—to test in estuaries located in southern California and in North Carolina's Back Sound, part of the overall Pamlico Sound estuarine system.

Using wire-mesh cages to exclude predators, Peterson laid one layer of clams "cheek to jowl." On the shoulders of the first layer, he laid another layer of clams to double the density. Peterson wanted to learn if a change in density would affect the clam's growth rate. "I wanted to get an idea whether the availability of resources were a limiting factor in growth," Peterson says.

In similar studies in California, Peterson had found that the growth rate of clams was cut in half when their density was doubled. But in Back Sound, double density meant double production. Why the difference? Food availability. The North Carolina clams had all the food they could eat. The California clams didn't.

The physical properties of the estuary help make it so productive. Nutrients are supplied from upstream rivers and the ocean. But North Carolina's shallow estuarine basin traps the nutrients and recycles them for continued use. In the California system, fewer nutrients are supplied from up-

stream and the estuarine basin is deeper, allowing less nutrient recycling.

If food is so plentiful, why aren't we waist-high in hard clams in Back Sound? The answer is simple. What's good for the hard clam is also good for the blue crab, the conch, the ray and the snapping shrimp, all predators of the hard clam. The food chain works to balance the account of the estuary's depositors.

## The estuary plays an important role as a feeding area for birds.

For migrating birds preparing to make a pit stop for food, the estuary is the best restaurant in town. Birds require a lot of food to fuel their rapid metabolisms. Naturally, they head for the place that offers the most food for the least amount of effort—the estuary. Whether the bird is a short-billed dowitcher probing for benthic worms or a least tern diving for fish, it can find large quantities of food in a relatively small area in the estuary.

Researchers have noticed that fall and spring migrations of shallow-probing birds such as the red knot or the American golden plover differ in length and intensity. Shallow-probing birds dine along intertidal flats, eating polychaete worms and small crustaceans.

During the spring migration, larger concentrations of shallow-probing birds spend less time in the estuary feeding than during fall migration. Why the difference? Food is more abundant during the spring when the estuary is at peak productivity. And spring tides are lower, offering the birds a larger area to scavenge.

Photo by Scott Taylor



Even seasonal and full-time residents like terns, gulls and egrets benefit from the estuary. While some species of terns and gulls are ocean-feeding species, others feed from the estuary. The shallow estuaries bring even bottom-feeding fishes close to the surface for birds to feed upon. And nearby land masses tend to block the wind, creating a flat water surface where prey are more easily seen from the air.

Because birds feed heavily on a wide variety of estuarine organisms, they tend to serve as a barometer for the estuary's health. Birds come at the end of the estuary's short food chain. And if production were limited or changed in the estuary, either because of man-made or natural reasons, the effects would almost immediately be seen in the birds that feed there.

—Nancy Davis and Kathy Hart



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



Any boater who's been caught in a summer squall knows that blue skies and calm waters can be deceiving. Within minutes, skies darken. Winds whip the boat. Waves splash the deck.

Newman Cantrell, of the Coast Guard office at Fort Macon, says there are some things you can do to prevent being caught in a squall. Get a weather report before you leave port. Listen to the National Weather Service channel for special broadcasts. If you notice a sudden coolness in the air, a quickening of the wind, or black, looming clouds, head for a safe harbor.

If you have to ride it out, be sure you're wearing a personal flotation device. The Coast Guard estimates that 85 percent of the people who drown each year would have lived if they had been wearing personal flotation devices.

Gad Degani, a visiting scholar to East Carolina University (ECU) from Israel's MIGAL Galilee Technological Research Center, will be working with Sea Grant researcher Margie Lee Gallagher to study the nutritional needs of the American eel. Partially supported by Sea Grant funds, Degani will spend six months in the U.S. on a post-doctoral fellowship.

In Israel, Degani had begun studying the possibility of using fermented cow manure as a feed for eels. He will continue his studies at ECU and at Sea Grant's Aquaculture Research and Demonstration Center in Aurora.



The North Carolina Humanities Committee has awarded a \$3000 grant to Lundie Spence, Sea Grant's education specialist, for one of her summer workshops. The grant will provide scholarships for 25 teachers and administrators to attend "America's 400th Anniversary Workshop" in Manteo, July 17-22. The workshop will focus on the nation's first colony—its culture and its environment.

The educators will collect native foods, visit the site of the Elizabeth II (a replica of an authentic 16th Century ship), and explore the archaeological digs that have provided historians with clues about the lives of those early settlers.

The workshop is sponsored by Sea Grant, the N.C. Department of Public Instruction, the 400th Anniversary Committee and the N.C. Marine Resources Center at Roanoke Island.



Many recreational fishermen like to catch enough shrimp to fill their freezers. But they have questions about what size net to use, what size otter boards or doors are best for their nets, and what horsepower motor yields the greatest catch at the lowest fuel cost. Wayne Wescott, a Sea Grant marine advisory agent in Manteo, has written a Blueprint that will help recreational fishermen answer these questions. *Recreational Shrimping* provides some tips for rigging a recreational boat for shrimping.

For a free copy, write UNC Sea Grant. Ask for UNC-SG-BP-83-2.

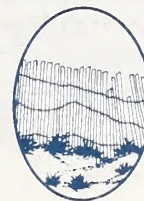
*Estimated Socio-Economic Impact in North Carolina of a Shortened Menhaden Season*, by Vito Blomo, Michael Orbach and John Maiolo of the East Carolina Univer-

sity Department of Sociology, Anthropology and Economics, explains the impact of a recommendation that would shorten the fishing season for menhaden in North Carolina. The recommendation was made to the N.C. Marine Fisheries Commission by the Atlantic States Marine Fisheries Commission to reduce the fishing pressure on menhaden, less than one year old, which have not spawned. The ECU team considered what changes the recommendation would have on fishermen and shoreside processing facilities.

For a copy of this working paper, write UNC Sea Grant. Ask for UNC-SG-WP-83-04. The cost is \$1.50.

*Understanding Septic Systems* a Blueprint written by Craig Cogger of the North Carolina State University Department of Soil Science, provides the homeowner with an introductory lesson into the operation of conventional and "alternative" septic systems. Systems such as the low-pressure pipe and mound systems can provide alternative waste treatment methods in marginal soils, particularly along the coast.

For a free copy of this Blueprint, write UNC Sea Grant. Ask for UNC-SG-BP-83-1.



Have you had a question on coastal law lately? Maybe you were getting ready to build a beachfront house and the maze of regulations and permits had you confused. Walter Clark, Sea Grant's new coastal law specialist, can tell you what you need to know to get through that maze. Clark comes to Sea Grant from the Office of Coastal Management where he's been in charge of the Coastal Area Management Act (CAMA) permit process. He holds a law degree from Wake Forest University and a master's in regional planning from the University of North Carolina at Chapel Hill. Each of his

*Continued on next page*



degrees concentrated on land use and environmental matters.

"When you speak of coastal law, you have to look at that big picture," says Clark. "Not just the beachfront, but the whole area. The estuarine areas, the sounds, the open waters. It's all part of coastal law."

If you would like to contact Clark, write him at the UNC Sea Grant College Program, 105 1911 Building, North Carolina State University, Raleigh, N.C. 27650 or call (919) 737-2454.



You just reeled in a fat flounder. You're already thinking about what good eating it will be when you get home tomorrow. But the only way that flounder will be good eating tomorrow is for you to take good care of it today.

All too often, fish reeled in by sports fishermen are wasted. They are left to bake in the sun or not cooled properly. The result is a fish that smells and tastes "fishy." But a fish that is properly chilled will have a good, fresh flavor.

Joyce Taylor, a Sea Grant marine advisory agent at the North Carolina State University Seafood Laboratory in Morehead City, offers this advice.

Chill a fish as soon as you take it out of the water. Smother the fish in

crushed ice. And by simply adding sea water to the ice, you can lower temperatures even more quickly.

If you can't freeze or cook your catch for several days, you might try superchilling it at the end of the day. If properly iced during the day and superchilled later, fish can be held up to seven days without loss of quality.

To superchill:

- Line the bottom of the ice chest with three to four inches of flaked or crushed ice. It's a good idea to place a rack or tray in the bottom of the cooler to keep the fish out of any water that accumulates as the ice melts.

- Layer the fish in a mixture of rock or table salt and flaked ice. Generally about a half-pound of salt should be used for every five pounds of ice.

- Whole fish should be layered, unwrapped, in the ice. Dressed fish should be individually wrapped in a clear, plastic wrap before layering.

- When the cooler is filled, top it with a generous layer of ice and securely close the lid and drain plug.

For more information about caring for your catch, write Sea Grant and ask for *Bringing the Catch Home* (UNC-SG-78-05).

It's time to register for the fall FINS (fish in natural studies) workshop, scheduled for Sept. 14-15 at the N.C. Division of Marine Fisheries Building, Morehead City.

Lundie Spence, Sea Grant's education specialist, says the workshop is designed for educators, particularly those with aquariums or touch tanks, who want to find out more about coastal fish. Participants will learn to identify various species and become familiar with the habitats and habits of those fish.

The workshop, sponsored by Sea Grant and the N.C. Division of Marine Fisheries, is limited to 15 applicants to be accepted on a first come, first serve basis. A \$10 fee will be charged to defray expenses.

For more information, write Lundie Spence at UNC Sea Grant College Program, North Carolina State University, Raleigh, N.C. 27650 or call (919) 737-2454.

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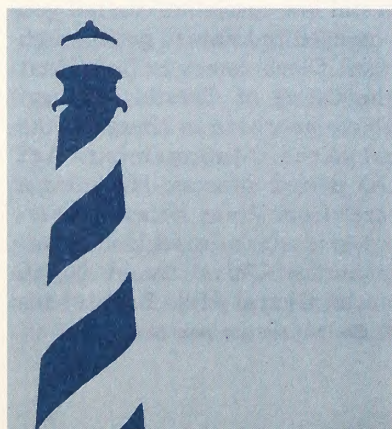
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# COAST WATCH

Photo by Wading Creek Photo Service



*Looking down into a box of soft-shell crabs packed for market*

The shell cracks, splits, and opens. What emerges is a tender fistful of some of the sweetest eating anywhere: the soft-shell crab.

It's a transformation so fleeting and lovely, fishermen refuse to call it molting. Crabs, they insist, peel. Or shed.

Peelers, they say, are hard crabs on their way to going soft. Shedders are the fishermen who help them on their way. Now that you know the terms, read about the whys and hows.

Inside, the business of crab-shedding, and the delectable soft crab.



# Crabbers turn soft-shells into hard cash

If you're going to make a living as a commercial fisherman, you've got to be willing to try a little bit of everything, says Milton Styron, a fisherman from Davis. "I'm a full-time, one hundred percent commercial fisherman," he says. And the emphasis is on 'commercial.'

For three generations, the Styrons have been working at the business of fishing. That meant going wherever there were shrimp, oysters, clams, scallops or crabs.

And through all those years, they've been producing soft-shell crabs in floating trays in Core Sound. Lately, their crab-shedding has paid off. Styron says he gets as much as \$20 a dozen for his soft crabs at the opening of the season in spring.

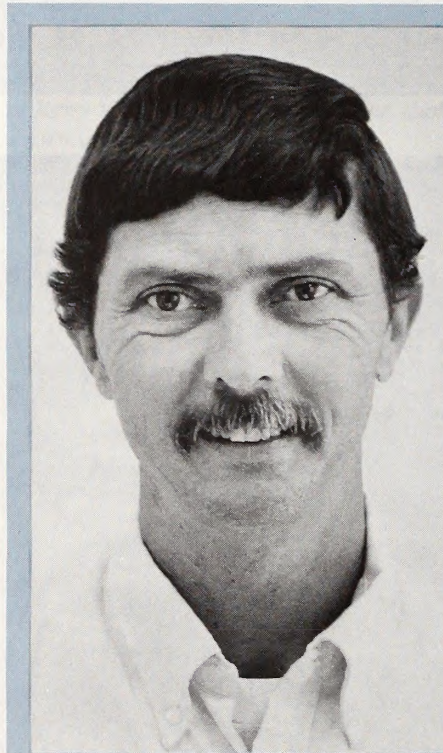
But he says the money hasn't always been that good. "I can remember back ten or twelve years ago when soft crabs were only bringing a dollar a dozen," says Styron.

That was before most people knew you could eat a soft crab, legs and all. Years ago, peeler operations were common in the state, but then fishermen decided shedding wasn't profitable enough, says Sam Thomas, Sea Grant's seafood specialist at the NCSU Seafood Laboratory in Morehead City.

Now soft-shell crabs are becoming known as a delicacy and command a high price, particularly from buyers in the North.

Fishermen can land extra profits if they're willing to cull out peelers and hold them until they shed, says Wayne Wescott, a Sea Grant marine advisory agent in Manteo. Since crabbers have access to peelers, the two enterprises naturally go hand-in-hand.

"Often a crabber either doesn't take the time to sort his catch or, in some cases, he might not know how to identify the peelers. With a little bit of effort, they can get a better price for their crabs," says Jim Murray, Sea Grant's advisory services director.



"Not only is the soft crab good to eat, but the quantity of edible meat exceeds that of the hard crab by ten to fifteen times."

—Wayne Wescott

Wescott says basic economics has encouraged crabbers to sell both hard and soft-shell crabs. "Not only is the soft crab good to eat," says Wescott, "but the quantity of edible meat in a soft crab exceeds that of the hard crab by ten to fifteen times. Because of this, the dollar value of soft crabs is much higher than that of hard crabs per individual crab."

At the start of the season in 1983, the highest recorded price for hard crabs was \$1 per pound. At the same time, soft crabs were bringing as much as \$2.33 each or \$28 per dozen in New York. (Wescott estimates that two to three hard crabs weigh one pound.) While prices for both soft and hard shell crabs come down as the season progresses, soft crabs bring a higher unit price than hard crabs throughout the season, says Wescott.

If commercial fishermen catching hard crabs were to save their peelers for the crab-shedding trays, North

Carolina's soft crab production could more than double, says Wescott. Maryland is the leading producer of soft crabs. Virginia is second. North Carolina and Louisiana compete for third.

But North Carolina soft-shell crab production is increasing. From 1981 to 1982 landings of soft-shell crabs almost doubled in North Carolina, says Terry Sholar, a marine biologist with the Division of Marine Fisheries. Sholar attributes that increase to the numbers of fishermen who have been giving soft-shell crabbing a try.

In March, Sea Grant sponsored a statewide workshop to bring fishermen up-to-date on crab shedding. Over 250 commercial fishermen attended and several hundred other fishermen have contacted marine advisory personnel for information on shedding crabs. In an informal survey of the workshop's participants, 47 percent said they added or changed a shedding operation af-



"I can remember back ten or twelve years ago when soft crabs were only bringing a dollar a dozen."

—Milton Styron

ter attending the workshop. As a result, those fishermen were able to shed an additional 570 dozen crabs. They reported making new investments averaging \$1,229.

(During crab-shedding season, Sea Grant operates crab-shedding demonstration facilities at the Marine Resources Centers in Manteo and Bogue Banks and at the Aquaculture Research and Demonstration Project in Aurora.)

Mark Hooper, a commercial fisherman from Smyrna, has his crab-shed-

ding trays set up onshore. He says he starts looking for peelers at the beginning of March. By April, he's shipping his first soft-shell crabs to the Fulton Market in New York. For him, it's not a full-time venture. "Down here, it just fills in nicely between seasons."

North Carolina crabbers have the advantage of getting their crabs on the market a couple of weeks before the Chesapeake fishermen. That means the biggest profits are made early in the season. Prices begin to go down as more crabs from Virginia and

Maryland get on the market.

For that reason, most fishermen don't have large shedding operations. Like Mark Hooper, they find that soft-shell crabbing is a way to increase their profits in spring.

But for Murray Bridges, a Collington soft-shell crabber, it's a full-time business. Bridges buys peelers from local crabbers, sheds them, and ships them to New York and other northern states. In May and June of this year, he produced 12,000

Continued on next page

Photo by Steve Murray



Collington crabber Murray Bridges checks shedding trays for soft-shells



"I wouldn't be in it if it weren't profitable."

—Murray Bridges

dozen soft crabs. For those crabs, he got as much as \$18 per dozen and as little as \$9 per dozen.

Before you try to figure out how much money he made this year, Bridges says you'd better consider his operating costs. He has 80 shedding trays, which he set up at a cost of about \$100 apiece. Add to that the cost of keeping his pumps running, his freezer cooling and his lights on. Then there are the costs of cartons for shipping and for freight to northern markets. In all, Bridges estimates his weekly operating costs are about \$1000. Still, he says he's not discouraging other fishermen from soft crabbing. "I wouldn't be in it if it weren't

profitable," he says.

Not all crab-shedding operations are so large. Larry Holden, owner of Holden Seafood in Shallotte, started shedding crabs last year. He set up twelve tanks at a cost of about \$100 each. He says his first season wasn't profitable because there just weren't many crabs to be had. He only shed 2,000 crabs—not enough to cover those initial costs.

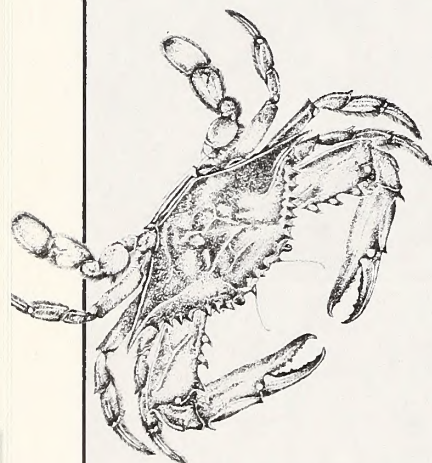
Milton Styron agrees that mother nature didn't produce many peelers during the 1983 season. In 1981, a good year, he shed about 1,200 dozen crabs. So far this year, he has only produced about 170 dozen.

But when the season is good, there's

no problem with marketing your crabs, say soft-shell crabbers. Terry Conway, owner of the John T. Handy Company in Crisfield, Maryland, agrees. The Handy Company is the largest distributor of soft-shell crabs in the country. Conway says, "You usually don't have to worry about a market for your soft crabs. Fortunately, demand usually exceeds supply."

Conway's advice to a fisherman just beginning to shed crabs is to focus on the quality of his crabs. "Soft-shell crabs are just like any other food commodity," he says. "The person with the highest quality gets the best price."

— Nancy Davis



## Blue Crab Biology

**A** blue crab isn't afraid of coming out of its shell. In fact, the blue crab molts from 20 to 30 times during its three- to four-year lifetime (females shed slightly fewer times than males).

The blue crab must shed its exoskeleton to grow because its shell, made up largely of chitin, produces no growth cells. Small crabs increase in size 30 to 50 percent after each molt, while larger crabs increase 20 to 30 percent. Very small crabs shed every three to five days. As the crabs grow larger, they shed less frequently. Large crabs molt every 30 to 50 days.

With some exceptions, the female ceases to molt when she becomes sexually mature. An immature female or

"she-crab" has a triangular abdominal apron, while one that has reached maturity, a sook, has a semi-circular apron. Only during the final molt can the female blue crab mate.

The courtship of the blue crab is marked by the gallantry of the males. After attracting a soon-to-be-mature female, the male cradles the female beneath him with his swimming legs until she molts, which may be as much as a week away. Crabbers refer to the pair as "doublers" or a "buck and rider." During the female's final molt, the male continues to protect his future mate by making a cage around her with his body. Once the female has molted, the pair mate and the male again cradles the female until her shell hardens.

Shedding requires all of the strength the crab can muster. Wiggling out of the old shell can take up to three hours and some crabs, especially older ones, may die in the process. Sapped of its strength and soft in body, the blue crab is especially vulnerable to attack from predators and even from its own hard-shell brothers.

For one to two hours after shedding, the crab absorbs water and completes the expansion of its new shell. After about four hours, the crab will begin to harden unless it is taken from the water. When the shell feels leathery to the touch, the crab has become a "papershell" or "buck-ram."

Between 24 and 48 hours after molting, the crab's shell reaches its premolt hardness.



**I**t takes good water, skill and some time to shed blue crabs. It also takes live crabs, ready to molt. And North Carolina has an abundance of those.

Wayne Wescott says that thousands of North Carolina's coastal residents have access to the resources they need to begin producing soft crabs.

More and more people, Wescott says, are turning to crab-shedding as a hobby, an avocation, or a career. Every week he fields dozens of questions—How much time does it take? Is it costly to get started? How much money can I make? Wescott says the answers depend on what sort of crab-shedding you want to do. He recommends that people begin with some reading and thinking, before they invest their money. Here are some of the basics:

## Finding 'peelers'

Peeler crabs, or those ready to molt and become soft crabs, are harvested most of the year (except in winter, when blue crabs are dormant) in the estuary. You can catch them one-by-one in small dip nets along the shoreline. This is a laborious method, but one that pays off in peeler crabs in good condition.

You can catch female peelers by "baiting" a wire trap—called a crab pot—with a large male crab. Virginia crabbers have been successful with a "peeler pound," a variety of pound net that directs crabs into a submerged trap. Louisiana crabbers have used a "bush line"—branches of wax myrtle tied to a floated line—which attracts peelers in search of cover.

Many crab-shedders simply use one of the traditional crab-fishing methods, such as pots, trawls, or trotlines, and

## 'BUSTING' INTO THE BUSINESS OF

# Soft-Shell Crabbing

sort peelers and soft crabs out of the hard-crab catch. Wescott says that some crab-shedding operations can acquire soft crabs and peelers by arranging to buy them from hard-crab fishermen.

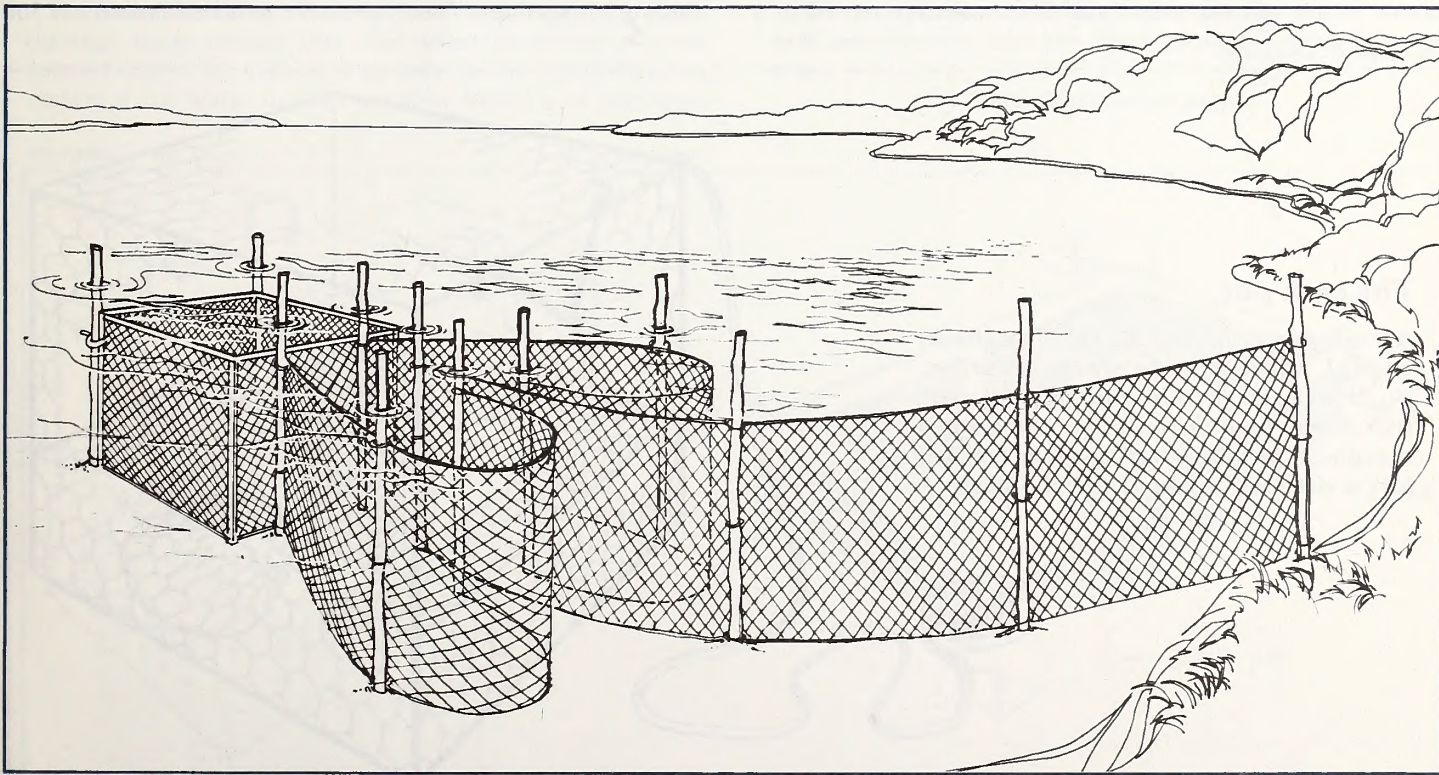
## Identifying peelers

However you get your crabs, the trick to successful shedding is recognizing the peeler. Experienced crabbers often look at the translucent edge of the crab's paddle fin, where subtle colorings betray the ready-to-molt crab. On the following page is a list of some of the telltale signs. The estimated number of days to molt are given for crabs measuring at least three and one-half inches, point to point. Smaller crabs molt more frequently.

- *White-line* peelers are in the earliest phase of pre-molting. They show a light, almost transparent line along the outer edge of the last two joints of the paddle fin. These peelers are usually at least five and sometimes 14 days away

Continued on next page

*Illustration by Sue Sunday*



*The peeler pound guides the crab along the net and into the trap*



from shedding, and some shedders have found that keeping peelers that long is unprofitable. Many white-line peelers die in the shedding trays.

- **Pink-line** peelers show a pinkish tint just inside the outer edge of the last two joints of the paddle fin. These peelers are usually two to six days away from molting and are, along with red-lines, "ripe" or "rank" for peeling.

- **Red-line** peelers show a deeper red in place of the pink. They are one to three days away from their molt.

- **Busters** are molting crabs whose shells are opening to let the soft crab "bust" out.

There are other signs and methods for guessing when a crab will molt. Some of these, such as nicking a claw to see the developing soft claw underneath, distress the crab and increase mortality.

Wescott says that although the color-line methods of identifying peelers require some practice, they produce the best result.

## Handling peelers

After you've caught your soft crabs or peelers, handle them very carefully on the boat. Keep them away from hard crabs, which will eat soft crabs. Soft crabs are stored in a

container of seawater until they can be iced or sold. Lay just-caught peelers on wet burlap in shallow baskets with covers. Shade them on their way to the shedding trays.

Busters, which are weak and helpless from the ordeal of molting, must be pampered. Keep them in a bucket of water and change the water every hour to introduce oxygen.

Wescott says you should keep all crabs away from chemicals and fuels. Never pile them on top of one another, or dump them into their containers.

## Shedding methods

North Carolina crabbers are using three different methods to shed crabs. There are variations for each method, but here are the basic systems:

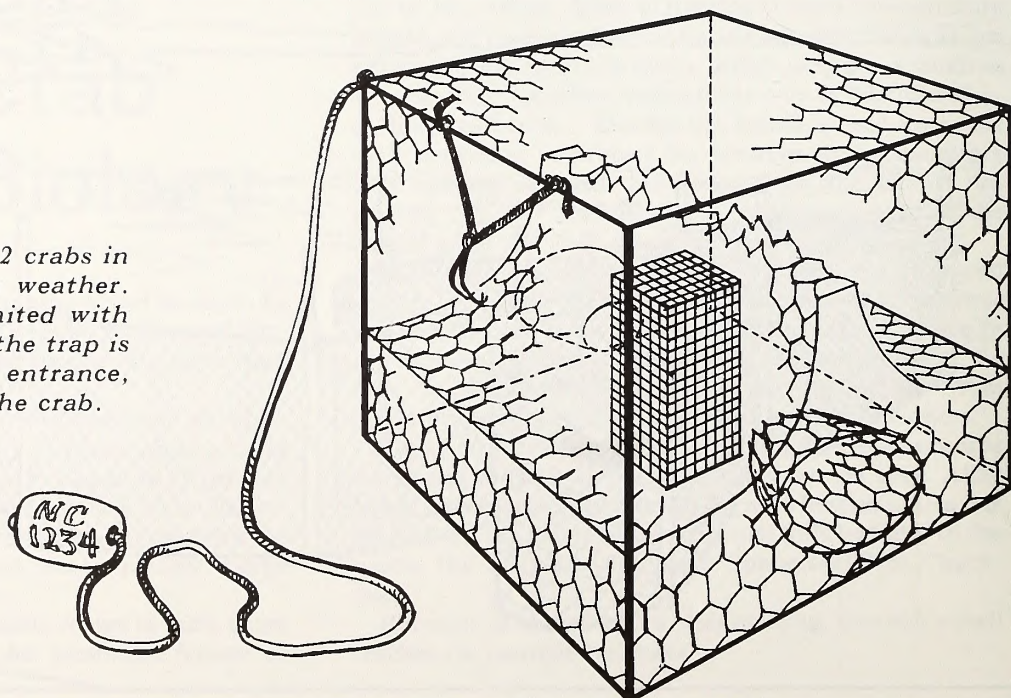
- **Floating shedders** are the most economical shedding systems. Shallow trays, often four feet by eight feet by twelve inches deep, are anchored in a creek or sound. Water flows in and out of the tray through openings in its sides and bottom. Floats keep the shedder's bottom a few inches below the water's surface.

Floating shedders are a good choice if you have waterfront property and conditions suitable for shedding crabs—clean, brackish water with tidal or wave action sufficient to aerate the shedder. These systems can house as many as 500

*Illustration by Sue Sunday*

### *The crab pot*

*A crab pot can trap 10 to 12 crabs in several hours during warm weather. Built of wire mesh and baited with fish heads or fish remains, the trap is designed to allow an easy entrance, but a difficult escape, for the crab.*





peelers when the water is around 70 degrees, early in the season.

The disadvantages? Shedding production drops off as the water warms beyond 72 degrees. And Wescott points out that fishing, checking and maintaining the shedders is inconvenient, often requiring the crabber to wade or use a boat each time he or she checks the trays.

- **Flow-through shedders**, placed along the shore, are more convenient and are popular among North Carolina crabbers. They are often very productive, and some house 500 or more peelers in each tray, when the water is cool.

The trays are similar in size to the floating shedders, but are mounted on legs. They are water-tight and are fitted with plumbing and pumps that circulate water from a brackish creek or sound through the shedders.

If the water you have is dirty or full of debris, you will need to filter it before it reaches the shedders.

These flow-through systems rely on electricity to keep them running, so energy costs are somewhat higher than with floating shedders. Also, Wescott warns that crabs will die if a power failure shuts down the pump, unless there is a backup power supply handy.

Wescott says that the convenience and simplicity of these flow-through shedders has made them very successful.

- **Closed-system shedders** are similar to the flow-through types except that the water is continually circulated within the system. You may need a closed shedding system if the water in your creek or sound is of very poor

quality, or if your property is not on a waterfront.

Closed systems rely on filters and devices called protein skimmers to remove waste. Water for these systems is often pumped from a well and treated with chemicals to simulate natural conditions.

Because of the extra filtering, treating and re-circulating of the water, closed systems are more expensive to build and operate than the other types. But Wescott says they can nevertheless be operated profitably in many coastal areas, if they are carefully maintained.

## Maintaining shedding systems

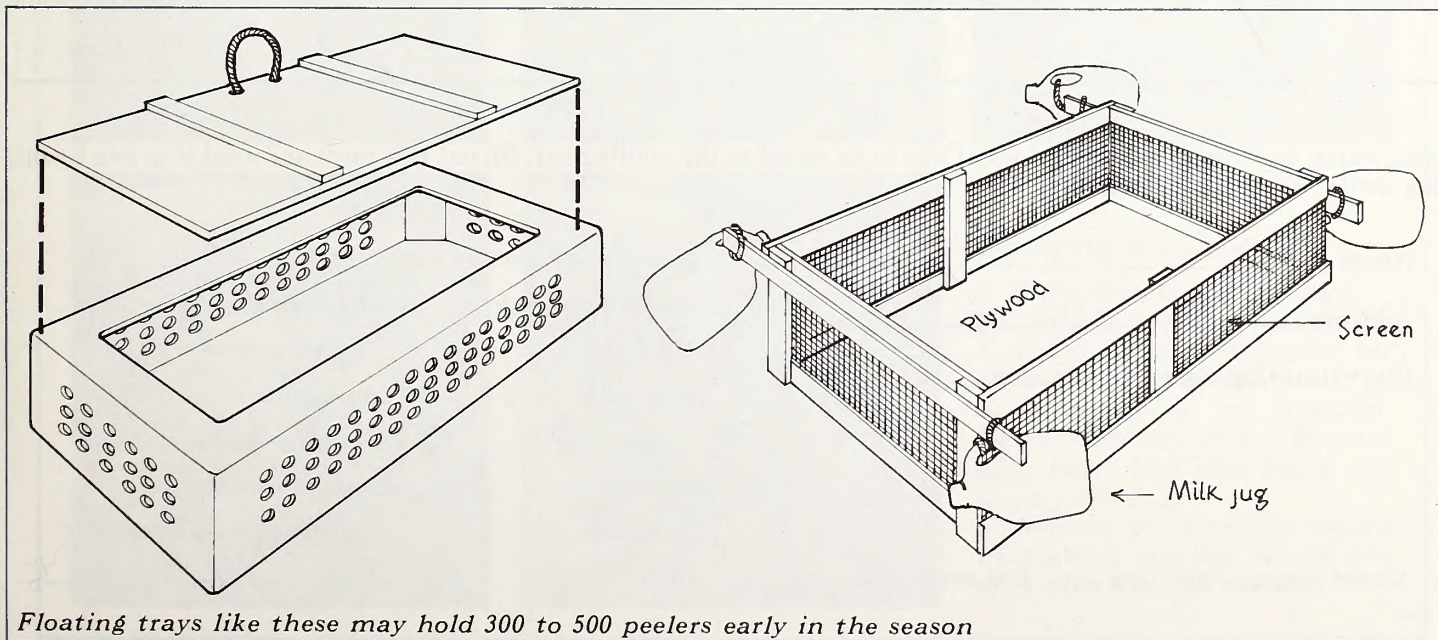
The floating shedders require the least maintenance of the three types of systems. Wescott advises you to haul out each floating shedder for a day at a time, every couple of weeks, temporarily distributing its crabs among other trays. He says a day or two of sunshine will kill growths and parasites that might otherwise reduce the life of the trays.

Flow-through and closed shedding systems require regular scrubblings and inspections. Valves and pipes must be cleaned, and pumps and wiring inspected each season. Filters need regular cleanings through the season.

All the systems must be checked for the proper salinity and temperature, and the trays protected from birds and other predators.

Continued on next page

Illustrations by Sue Sunday



Floating trays like these may hold 300 to 500 peelers early in the season



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## Fishing and checking the system

There is one problem common to all crab-shedding operations: They take a lot of time. Even in small operations, crab-shedding demands attention seven days a week, around the clock.

You must catch or buy your peelers. You must cull out dead crabs and discarded shells, sort peelers by stages, and check the shedding trays at least every six hours for soft crabs.

Timing is important. Many large crab-shedding operations check for soft crabs every four hours, to prevent them from hardening to the "paper-shell" stage. Soft crabs must be given an hour or two to firm up, then they should be removed from the water and cooled to stop their shells from hardening any further.

## Preparing soft crabs for market

North Carolina shedders who can reliably produce high-quality soft crabs never have trouble selling their product, Wescott says. But many buyers are very particular about the condition and packaging of the crabs they choose.

Restaurants, which buy many of the soft crabs shed in North Carolina, usually insist on nice-looking crabs with at least one claw each, and most want crabs packaged in uniform sizes, according to a prescribed method of boxing and wrapping. Most buyers prefer live soft crabs, chilled and dormant and packed one layer deep in shallow boxes. Many, however, will accept fresh-frozen soft-shell crabs, if they are properly cleaned, frozen and packaged. (See story beginning on page 9 for information about cleaning.)

Live soft crabs sold to distributors in North Carolina, Virginia, Maryland, New Jersey and New York must meet standard packaging and quality requirements.

"Stills," or crabs that die during or after shedding, are not shipped with live crabs. They are salable only if cleaned and frozen promptly. Stills with an odor should be discarded.

As with other seafoods, commercial freezing equipment, operating at -20 degrees Fahrenheit, produces the best product. But these freezers are also too expensive for most small shedding operations. Wescott says that some crab-shedders do use household freezers, which will hold crabs at around 0 degrees Fahrenheit.

## Anyone can learn

Although these techniques take some time to master, Wescott says that most anyone can learn them. And a fisherman handy enough with tools to keep a boat in good repair can usually save some money by doing the carpentry, plumbing and electrical work himself.

Wescott adds that, while crab-shedding is no get-rich-quick scheme, a strong market, respectable profits and relatively low start-up costs have made the business attractive.

"There's room for a lot more crab-shedding operations before we reach the limits of the market," he says. "And a lot of people who fish for hard crabs could be sorting out the peelers they catch, and getting more for their effort."

*[If you want to know more about setting up a crab-shedding operation, contact Wayne Wescott at the Sea Grant Marine Advisory Service office in the N. C. Marine Resources Center on Roanoke Island (P.O. Box 699, Manteo, N.C. 27954). His telephone is (919) 473-3937.]*

— Neil Caudle

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Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, Box 5001, Raleigh, N.C. 27650.

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|---|--|
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| <input type="checkbox"/> Educator               | <input type="checkbox"/> Seafood processing/marketing    |
| <input type="checkbox"/> Farming                | <input type="checkbox"/> State government                |
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| <input type="checkbox"/> Lawyer                 | <input type="checkbox"/> Other _____                     |

Coastal property owner ☐ yes ☐ no Boat owner ☐ yes ☐ no

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# Soft-shell crabs come battered and fried

**A**sk a coastal cook how she or he prepares soft-shell crabs and the answer is almost always the same: fried. From posh restaurants in New Orleans to the down-home kitchens in Dare County, cooks batter and fry the soft-shell crab.

"Frying is the only way," says 77-year-old Helen Scarborough of Manteo. "And that's the way we've always fixed our soft crabs." Scarborough cleans her crabs, then salts and peppers them. She dips the crabs in a batter made of evaporated milk and flour (Occasionally an egg is added). Then Scarborough drops the crabs in hot, deep fat, frying them to a golden brown.

While it seems everybody prefers soft crabs fried, cooks do differ in their choice of batters. Emma Avery, a Carteret County cook, coats her crabs with an egg-and-flour batter. No milk. Collington shedder Murray Bridges says he dredges his soft crabs in flour only. "The flour holds in the moisture while frying," he says.

Sherry Creech, manager of The Charter Restaurant in Morehead City, says cooks there salt and pepper the soft-shells before thoroughly coating them with flour.

"Flour is the best coating for soft-shells," she says. "Flour has a lighter texture than cornmeal and it retains less grease. And because flour provides a more even coating than cornmeal, it holds in more moisture."

"And we never fry soft-shell crabs in the same grease we fry any of our other seafoods. Soft-shell crabs will pick up the stronger flavors of other seafoods if they're cooked in the same grease."

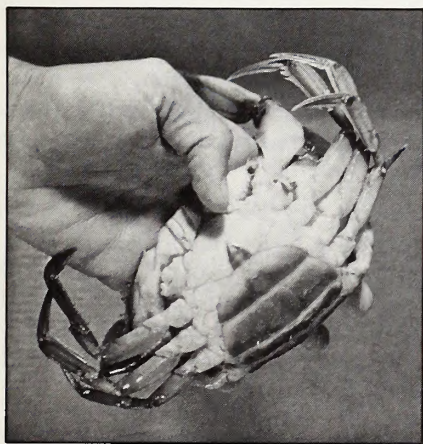
Creech says The Charter does broil soft-shell crabs and occasionally grills them for customers who request it. For broiling, the crabs are rubbed with oil, sprinkled with minced garlic and topped with seasoned bread crumbs, Creech says. Broiling sometimes makes the top shell tough, Creech says, and the crab more chewy.

The demand for soft-shell crabs has increased in recent years, Creech says. "We now prepare about sixty dozen soft-shell crabs a week," she says.

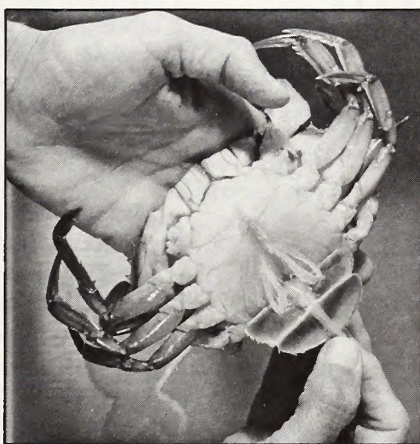
Eating a soft crab means eating the whole thing except the eyes, mouth, apron and lungs, which are removed before cooking.

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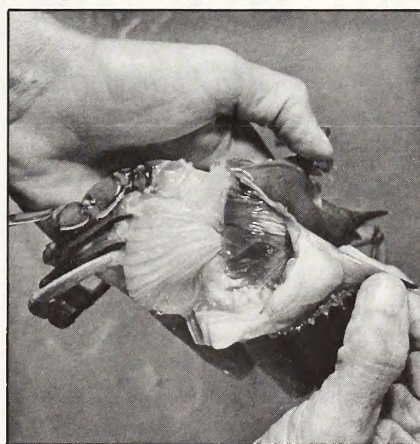
Photos by Steve Wilson



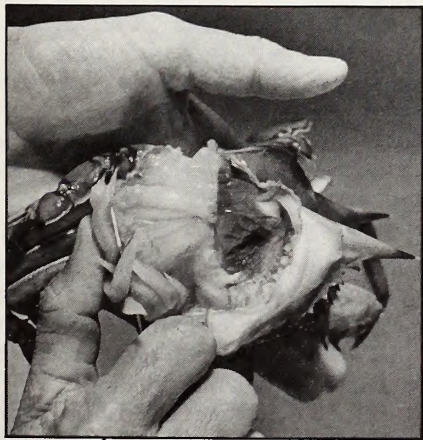
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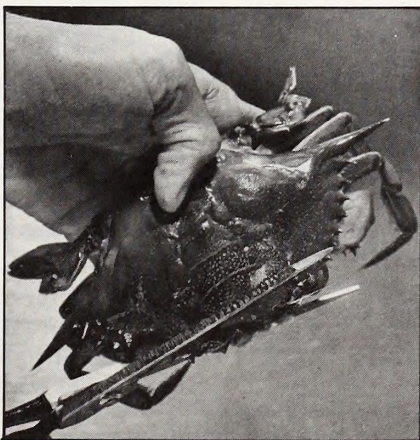
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## *Cleaning a soft-shell*

1. Turn the crab on its back.
2. Lift and remove the apron.
3. Turn the crab over and lift the left lateral spine.
4. Scrape away the grayish-white feathery gills. (Remove gills from left side using the same procedure.)
5. Remove the eyes and mouth by making one cut behind the eyes with kitchen shears.



Though soft-shell crabs are considered a coastal delicacy by many, they are not always served with a flourish. Many coastal folks like them fried and sandwiched between two slices of bread spread with mayonnaise, says Joyce Taylor, Sea Grant's marine advisory agent at the NCSU Seafood Laboratory in Morehead City.

No one knows exactly when it was discovered that the crab in its softened state made such good eating. Avery, who is 81, says she has been eating soft-shell crabs since she was a little girl. "I remember when soft crabs could be bought for twenty-five cents a dozen," she says.

During late July, a dozen soft-shell crabs were selling for \$10 to \$12 at seafood markets and from local shedders in Carteret and Dare counties.

When buying soft-shell crabs, coastal cooks say to buy the crabs alive or frozen. Never buy a soft-shell crab that is dead unless it is frozen, says Janice Tillett of Manteo. Top-quality crabs should have all of their legs and at least one claw. Occasionally, shedders will sell damaged crabs, missing claws and legs, at reduced prices.

Buying soft-shell crabs alive means buying the crabs at

coastal seafood markets or from shedders. Few, if any, inland seafood markets handle the soft-shell crabs alive. "We had problems keeping them alive until they are all sold," said a spokesman for one seafood market in Raleigh.

If you buy frozen soft-shell crabs, they should be checked to make sure they show no signs of freezerburn, Taylor says.

To clean a soft-shell crab, wash it thoroughly. Turn the crab on its back, lift and remove the apron. Turn the crab over. Lift the large lateral spines of the shell top, and scrape away the grayish-white, feathery gills. Remove the eyes and mouth by making one cut just behind the eyes with a knife or kitchen shears.

Some cooks advocate removing the top shell completely and scraping away the digestive sac. Tillett says the digestive sac will leave the soft-shell crab with a sour flavor unless it is removed. Creech says The Charter also removes the sac for the same reason.

— Kathy Hart

## The skillet's good But so's the grill

While frying is the method most preferred for cooking soft-shell crabs, here are a few alternative ways to prepare soft-shell crabs:

### Baked Soft-Shell Crabs

12 soft-shell crabs  
¼ cup milk  
¾ cup flour  
2 eggs, beaten  
2 teaspoons salt  
¾ cup dry bread crumbs  
½ teaspoon pepper  
(garlic powder and cayenne pepper are optional spices that may be used)

Combine salt, pepper, eggs and milk. Combine flour and crumbs. Dip crabs in egg mixture and roll in flour/crumb mixture. Place crabs in a shallow, buttered baking pan. Put a pat of butter on each crab. Place pan in preheated 400° F oven for 8 to 12 minutes, or until browned.

*Virginia Sea Grant Program*

### Grilled Soft-Shell Crabs with Seafood Marinade

1 cup salad oil  
2 tablespoons white vinegar  
1 teaspoon salt  
¼ teaspoon tarragon  
1 teaspoon lemon and pepper seasoning  
⅛ teaspoon lemon zest or 1 teaspoon lemon juice  
⅛ teaspoon garlic powder

Mix above ingredients together. Let stand several hours at room temperature to let flavors blend.

Liberally baste bottom side of 12 soft-shell crabs with marinade and carefully place, bottom-side down, on grill.

Grill over a slow fire, at least 12 inches from coals, for five minutes. Liberally baste top of crabs with marinade, turn carefully and grill five more minutes.

Makes six servings, two crabs each.

### Grilled Soft-Shell Crabs

½ cup butter, melted  
3 tablespoons lemon juice  
2 tablespoons minced parsley  
½ teaspoon grated lemon rind

Make a lemon butter from above ingredients. Brush soft-shell crabs with it. Grill over medium heat, four to six inches from heat for seven to eight minutes. Turn. Cook until lightly browned and done, about seven to eight more minutes. Baste often while cooking.

*NCSU Seafood Laboratory*



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



North Carolina fishermen are reporting disappointing shrimp catches this year, particularly in western and northern Pamlico Sound, says Ed McCoy, of the Division of Marine Fisheries in Morehead City.

News reports blame the heavy rains that fell earlier this year and the resulting lower salinity levels in the estuary. But is it that simple?

Sea Grant researcher John Miller says probably not. Instead, he says it's more likely that heavy rainfalls indirectly affected the shrimp. "The same weather conditions that affect salinity also affect a lot of other things. And those may be the things causing reduced numbers of shrimp," says Miller.

He says it's important to remember that shrimp is an annual crop. "The number of shrimp in 1983 is a direct function of the number of shrimp produced in 1982," says Miller. So, it may be that fewer of the shrimp spawned last year actually survived.

Shrimp larvae rely on currents to move them from offshore where they're spawned to the estuarine nursery areas where they'll mature. Weather conditions may have resulted in a lack of currents for the shrimp to migrate toward the estuary.

Once the shrimp reached the estuarine waters, it may be that abnormally low salinity levels stressed them, says Miller. The low salinity levels also may have stressed the food supply on which the shrimp feed.

In turn, the low-salinity environment may have been conducive to a disease organism or to an organism that competes with the shrimp for food, says Miller.

McCoy says the heavy rains came in March, April and May—the critical months for the brown shrimp. But there is hope for the shrimp fishery in North Carolina, McCoy says. The critical months for pink shrimp are June, July and August. The heavy rains probably won't affect that species, he says.

On Aug. 1 Congress approved the reauthorization of the National Sea Grant Program for 1984-85. The program was created by Congress under the National Sea Grant College Act and must periodically be reauthorized by Congress so it can continue to operate as a federal program.

The Senate Committee on Appropriations has voted to increase the 1984 budget for Sea Grant by 10 percent. The UNC Sea Grant College Program is in the process of preparing and submitting its 1984 renewal budget request to the National Office of Sea Grant.



Spencer Rogers, Sea Grant's coastal engineer, has received a prestigious award for outstanding extension service from North Carolina State University (NCSU). Rogers was one of only ten university extension workers to receive the award this year, and is the first Sea Grant marine advisory agent or specialist to be so recognized.

Rogers, who was recently named Specialist of the Year in UNC Sea Grant's Marine Advisory Service, was recommended for the NCSU extension award because of his work helping to solve coastal engineering, construction and shoreline-erosion problems.

Bruce Poulton, NCSU chancellor,

said that Rogers' "efforts and devotion to the application of knowledge for individual enrichment, community development, and public service exemplify the spirit and mission of our Land-Grant University."



Lise Knelson, a zoology graduate of the University of North Carolina in Chapel Hill, will be the first student to receive the North Carolina Marine Policy Fellowship. UNC Sea Grant Director B.J. Copeland provided project initiation funds for the program, which will be administered through the Institute for Coastal and Marine Resources at East Carolina University under the direction of Michael Orbach, a noted ocean policy researcher.

Knelson, who was elected to Phi Beta Kappa in 1981, concentrated her undergraduate work on the marine sciences.

Copeland says the fellowship program will train top students in marine policy, providing leaders that will help solve tomorrow's ocean-use problems.



The Neuse River Foundation sponsored a symposium on water quality and other related issues on Sept. 15. The Fairfield Harbour Symposium featured discussion from scientists, regulatory agency officials, city and county planners, and industrial developers on three main topics: municipal and industrial development, groundwater hydrology and water quality.

UNC Sea Grant Director B.J. Copeland conducted the session on water quality and Sea Grant researchers Hans Paerl and Donald Stanley presented some of their findings on the blue-green algal blooms of the Neuse

Continued on next page



River. For more information about the blue-green algal blooms plaguing the Neuse, read the October issue of *Coastwatch*.

Paerl and Stanley also discussed the problems of the Neuse in a public forum at the Sept. 8 and 9 meeting of the N.C. Marine Science Council at Bogue Banks.



Soils, roads, waterways, buildings and populations — They're all going into computers these days, as data. And now, more and more of North Carolina's coastal planners and managers can use a computer to map the resources in their communities.

A state agency—the Land Resources Division of the N.C. Department of Natural Resources and Community Development—has introduced the Land Resources Information Service (LRIS). LRIS is a computerized system that draws on "digitized" data to draft maps, overlays and displays that can help with the job of planning and managing coastal resources.

If you would like more information on LRIS, call (919) 733-2090, or write LRIS, N. C. Division of Land Resources, P.O. Box 27687, Raleigh, N. C. 27611-7687.



It's been twenty-three years since a hurricane crossed the coast of North Carolina. But that statistic can be deceiving, says Joe Pelissier, deputy meteorologist in charge at the National Weather Service forecast office in Raleigh. "From a statistical point of view, North Carolina is very hurricane-prone. In fact, if we go back over a hundred years of record, it turns out that, along the Atlantic coast, the coast of North Carolina is the second most vulnerable place for hurricanes, surpassed only by South Florida."

Could this be the year when another hurricane strikes our coast? Pelissier says there's no way of knowing. But he's concerned that if a hurricane does strike our coast, residents there may not be prepared. More and more people, many who have never known the force of a hurricane, are moving into the hurricane-vulnerable areas, says Pelissier.

To help people prepare for a hurricane, Sea Grant, the N.C. Division of Emergency Management and the N.C. Office of Coastal Management published a brochure, "About Hurricanes, what to do and when to leave." In conjunction with Hurricane Awareness Week, WRAL-TV in Raleigh adopted and reprinted the publication for mass distribution in their viewing area.

Mini-grant funds have been awarded to Vito Blomo, an East Carolina University (ECU) economist, to study the impact of a proposed minimum mesh size for menhaden nets. John Maiolo and Michael Orbach, also of ECU, will assist Blomo on the project.

Overfishing is a growing problem in the menhaden fishery. As a possible solution, the Atlantic States Marine Fisheries Commission is considering a regulation requiring a minimum mesh size for net materials. Currently, there are no regulations on mesh size for menhaden nets in North Carolina.

Earlier, the researchers studied how a shortened season might affect the employment and revenues of the menhaden fishing industry and regional economics.

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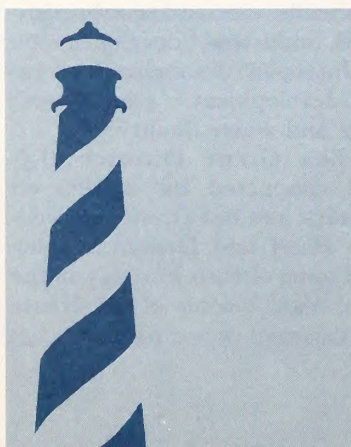
*Coastwatch* is published monthly except July and December by the University of North Carolina Sea Grant College Program, 105 1911 Building, North Carolina State University, Raleigh, NC 27650-5001. Vol. 10, No. 8, September, 1983. Dr. B.J. Copeland, director. Neil Caudle, editor. Kathy Hart and Nancy Davis, staff writers. Second-class postage paid at Raleigh, NC 27611.

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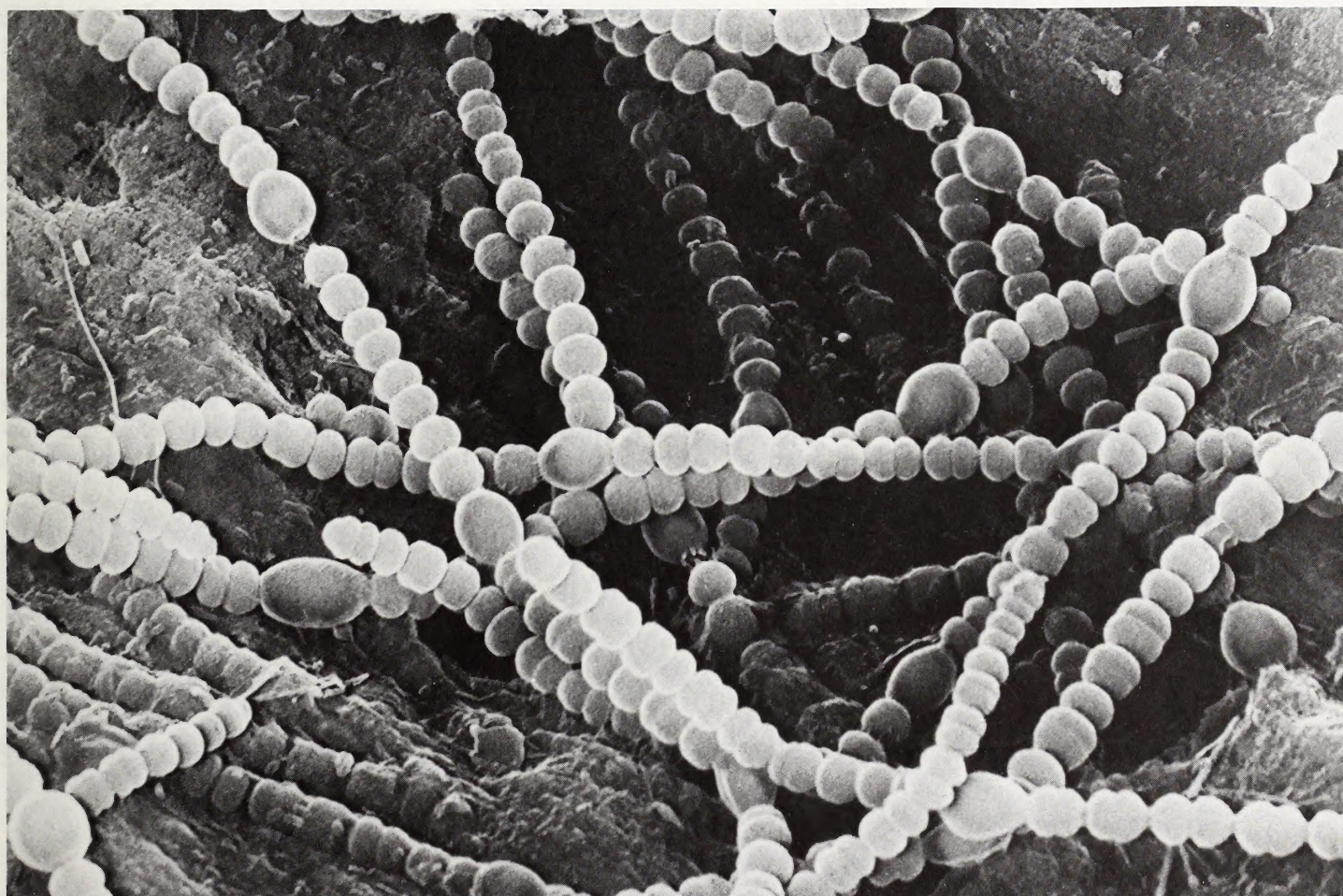
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# COAST WATCH



*An electron micrograph of nuisance blue-green algae*

## A bloom of algae

coated the Neuse River from Kinston to New Bern this summer. Residents along the river are learning to dread the smell of the algal slime. Boaters don't like the green wake behind their boats. Swimmers and water-skiers don't like the green scum on their bathing suits.

Those are the obvious effects. But the concerns go beyond the aesthetic, beyond the recreational,

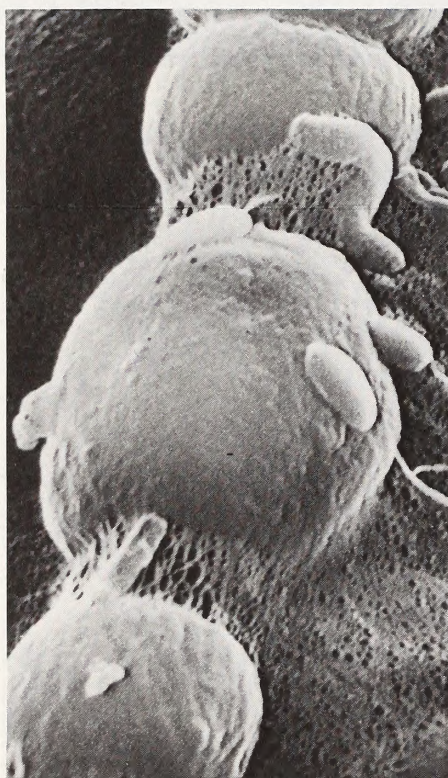
beyond the fresh water. The blooms are affecting the biological makeup of the river, and may ultimately affect what goes on downstream in the estuary—the estuaries that support our fisheries.

Solutions? Some are on the way. But at least one, a proposed ban on phosphate detergents, may be unpopular with some.

Inside, the causes, the impacts and the politics of the blue-green algal blooms on the Neuse River.



# Looking for answers in a bloom



All the conditions were right. Warm water—above 70 degrees Fahrenheit. Long, sunny days. A stratified water column with low river flow and calm wind. And, most important, plenty of nutrients.

The river was ripe for a bloom. The blue-green algal cells multiplied rapidly by division. The organisms gathered, rose to the surface and formed colonies. Soon the scum floated in big patches. The nuisance algae were taking over, and it would be months before the bloom's demise. And, even then, its effects would linger long after.

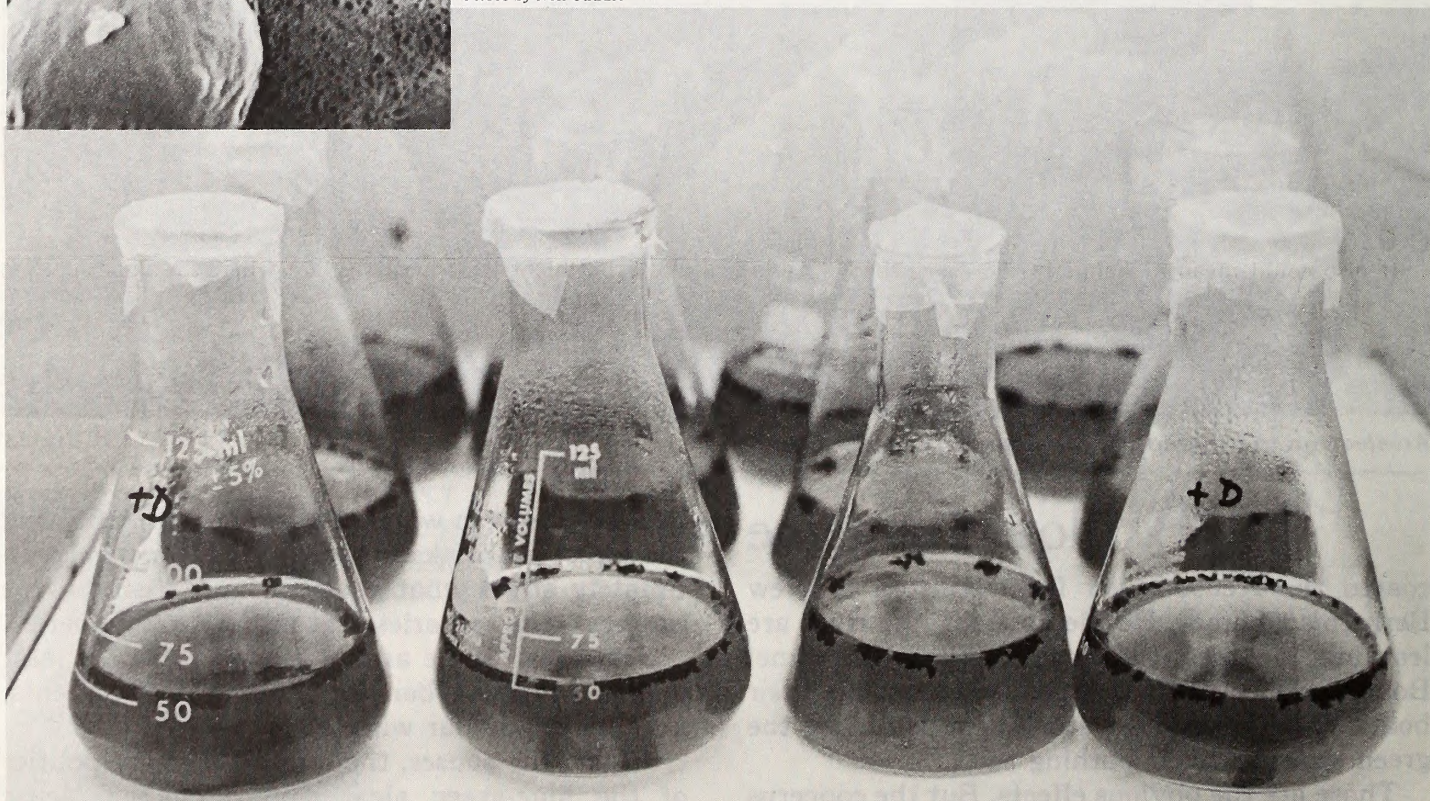
Sea Grant researchers Hans Paerl, Donald Stanley and Robert Christian have been studying the blue-green algal problem on the Neuse River. And, they all agree. Underneath all

that scum, even more drastic changes may be occurring—changes that may alter the chemical and biological make-up of the river.

Scientists attribute the blooms to the excess of nutrients being pumped into the river from upstream. (See story, page 4). Paerl has found that factors such as oxygen, salinity levels, temperature and sunlight affect the production and survival of blue-green algae. The difference between a bloom year and a non-bloom year is usually attributed to hydrological or climatic conditions, he says. Last year, for example, there wasn't a bloom on the Neuse because of the high river flow.

Other algae, some of which are desirable food sources for other organisms, fare badly when the blue-greens begin to take over. A blue-green

*Photo by Neil Caudle*



*Surface slime layer of blue-green algae and bacteria (top); Paerl's cultured algae stored in a refrigerator*



*"You find quite a different food chain than the one that's normally present."—Hans Paerl*

algal bloom excludes 95 percent of all the other algae in the water. That could mean bad news for the food chain. Paerl has found that blue-green algae are not a desirable food source and that the blooms are probably altering the food chain.

Zooplankton, a major food source for many fish and shellfish, feed on phytoplankton, the base of the food chain. But as soon as the blue-greens begin to take over, the zooplankters disappear from the water column. It may be that the blooms form particles too large for the zooplankton to eat or that the algae are toxic to the zooplankton.

Whatever the case, Paerl says the food chain undergoes major changes under bloom conditions. "You find quite a different food chain than the one that's normally present," he says. "Our experiments indicate there's not efficient transfer of this material into the food chain."

Since the larger zooplankton won't eat the algae, smaller organisms must consume the green scum. The smaller organisms may not be desirable food sources for fish in the food chain, says Paerl.

It also could mean a change in the fish community from plankton-feeders to bottom-dwellers. Paerl says, for example, catfish may survive the blooms on the Chowan while the striped bass population could suffer.

Paerl says there's such a supply of nutrients constantly being recycled in

the Neuse that, when conditions are right, a bloom can flourish for months without using up the supply.

Usually, it's a change in the weather or in the salinity of the water that kills a bloom. Paerl says blue-green algae can't tolerate even low levels of salinity. He's found that as river flow slows, the fresh water moves toward the salt water in the estuary at a slower rate. At the same time, the heavier salt water moves along the bottom in a "wedge," until it eventually mixes with the rest of the water column. When the salt wedge meets the bloom, the algae die and sink down the water column.

Once the algae are dead, the troubles are only just beginning, says Paerl. The oxygen demand from the decomposition process lowers the oxygen level in the water. This year, when the salt wedge moved into the bloom area, the oxygen level went from five milligrams per liter to less than one milligram per liter in one week—a drastic change, says Paerl. According to the state water quality standards, five milligrams per liter are necessary to support a variety of fish life.

Although there were no big fish kills on the Neuse as a result of that bloom, biologists say low oxygen levels often cause kills.

Stanley and Christian have found that the blooms upriver may cause even more changes in the estuary. After the bloom dies, its breakdown products are probably swept down-

stream into the estuary, says Christian. There they may decompose or settle to the bottom and become part of the sediments.

Stanley and Christian say that all that dead algae affect the nitrogen-cycling, or where the nitrogen atoms are going in the water, in the lower Neuse and in the estuary.

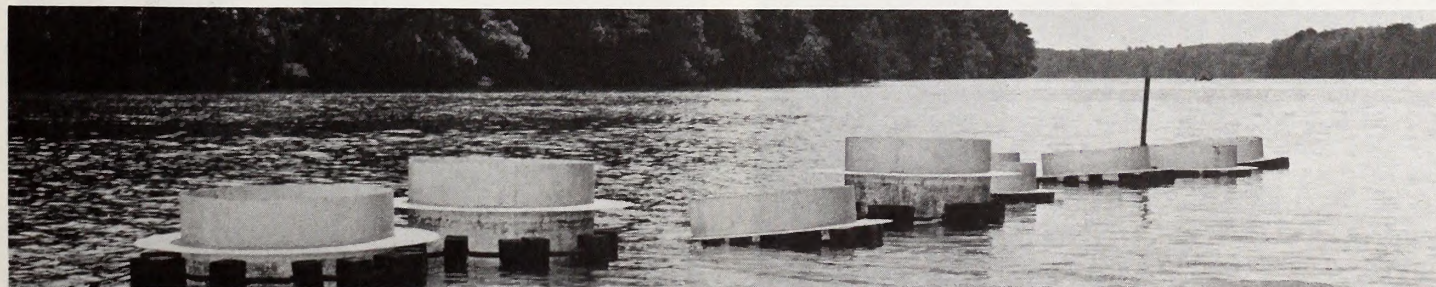
Under non-bloom conditions, there is a lot of inorganic nitrogen available in the estuary. But Stanley and Christian have found that, under bloom conditions, the algae use up that inorganic nitrogen and release organic nitrogen. That could mean that organisms that use inorganic nitrogen in the estuary may not be finding all they need.

One of the problems in studying an algal bloom is that the bloom lasts only a few months. Researchers are forced to take as many samples as possible during the bloom and retreat to the laboratory during the winter months to find answers to their questions.

Stanley and Christian have freezers full of blue-green algae they've collected from this year's bloom. By the time the next bloom is choking the Neuse, they may be able to answer questions like, where the algae go when they die, how the algae release nutrients in the decomposition process, and what effects the algae from upstream will have on the estuary.

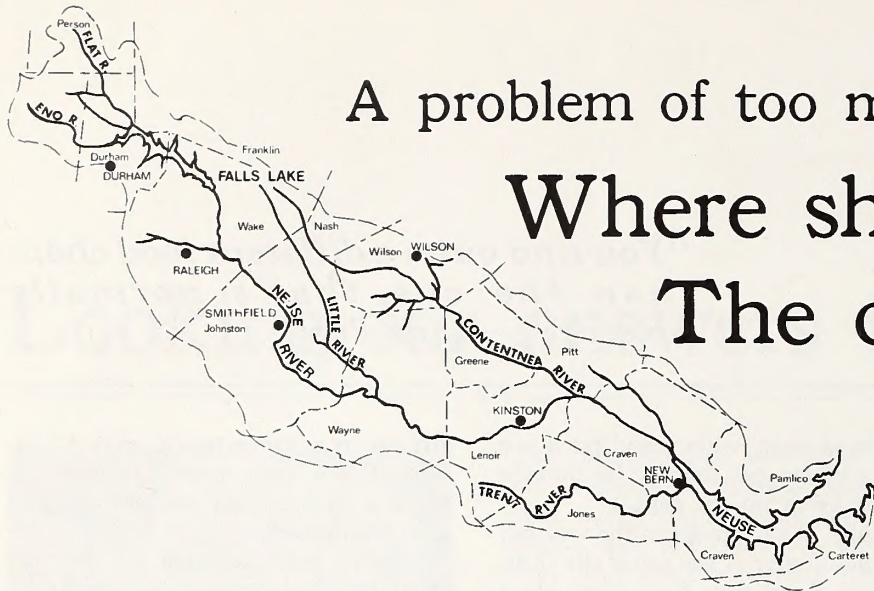
—Nancy Davis

Photo by Nancy Davis



*Paerl uses hydrocorrals like these to trace the fate of algal blooms*





# A problem of too many nutrients: Where should The cleanup begin?

From its headwaters near Hillsborough to its base in the Pamlico Sound, the Neuse River is a body of troubled water.

As the Neuse winds along its 220-mile course, 34 major municipal or industrial treatment plants discharge nutrient-rich effluent into its watershed. Urban run-off from the likes of Durham, Raleigh, Wilson, Smithfield, Kinston and Goldsboro wash more nutrients into the river. And the Neuse acts as a drainage basin for 1.1 million acres of prime farmland regularly dosed with fertilizer.

All of this run-off, effluent and drainage adds up to a river chocked full of nutrients, particularly nitrogen and phosphorus. And combined with the right weather conditions (see page 2), these nutrients can cause the river to blossom a malodorous scum of nuisance blue-green algae.

This summer a bloom coated the Neuse from Kinston to New Bern. Blooms developed as far upstream as Goldsboro. And state environmental officials warned that the newly completed Falls Lake Reservoir along the upper Neuse, slated to become Raleigh's sole source of drinking water by 1985, would face problems from algal blooms unless preventive steps were taken soon. And if the Falls Lake blooms, Raleigh residents are likely to taste the effects of the algae in their drinking water, scientists say.

*Photo by Nancy Davis*



*Paerl sampling the waters of the Neuse*

State officials, scientists and citizens are worried that the Neuse will follow in the footsteps of the Chowan River in northeastern North Carolina. Green mats of algae clogged the Chowan from Tunis to Edenhouse this summer, one of the most extensive blooms to plague the river.

The state issues an "algal index" for the Chowan, which rates the river from zero to 10 based on the size of the algal blooms. The higher the rating, the more algae present and the greater the interference with swimming, boating, fishing and wildlife. During late summer, the Chowan was rated at 8.5.

But the state Environmental Management Commission (EMC) has already classified the Chowan as "nutrient sensitive," a designation which allows the commission to place stringent controls on point-source discharge of effluent. Most of the sewage treatment plants along the Chowan will convert to land-application systems by 1986, to comply with an EMC ruling that limits phosphorus input to 1 milligram per liter. Most sewage treatment facilities found it cheaper to convert to land-application systems than to install chemical treatment equipment.

But not all of the Chowan's problems originate at North Carolina sewage treatment plants. Much of the river's basin lies in Virginia.

"If we can get agriculture and Virginia to do their part, we expect things to improve on the Chowan in the next five years," says George Everett, an environmental scientist for the water quality section of the state Division of Environmental Management (DEM).

The state's experience with the Chowan has prepared it for the eutrophication (rich in dissolved nutrients) problems now cropping up along the Neuse. Officials say they hope to slow the nutrient input along the Neuse before the problem reaches the magnitude of the problem on the Chowan.

But the state must be prepared to act quickly on the Neuse, Everett says. "We waited until things were bad on the Chowan before we acted," he says. "We can't wait that long on the Neuse. During our first five years of studying the Neuse, the problem has accelerated faster than we expected."

But Everett says the state needs to know how much nutrient reduction is needed before it starts imposing costly clean-up measures. "We're looking to Hans Paerl (Sea Grant researcher at the UNC Institute of Marine Science)



Some state officials believe a ban on phosphate detergents would be a beneficial first step toward lessening phosphorus levels in the Neuse and other state rivers. But the Soap and Detergent Association disagrees, saying phosphate reductions would be insignificant (about 11 percent in the upper Neuse).

George Everett of the Division of Environmental Management says the proposed ban alone may not be enough to solve the problem of algal blooms. But the ban used in conjunction with measures to control agricultural and urban run-off, might be enough to keep the state from imposing strict nutrient limitations, he says.

Besides disagreeing over the need for a ban, the groups are also at odds over the cleaning power of non-phosphate detergents. Bob Singer, vice-president for the New York-based association, says non-phosphate detergents require more hot water and laundry additives to do the same job. He says non-phosphate detergents also cause more wear on washing machines and clothes because the



## A Phosphate Ban?

cleaning substitute, sodium carbonate, combines with minerals in the water to form limestone deposits that accumulate on fabrics and in machines.

But state officials say precipitation won't be a problem in soft-water areas (87 percent of North Carolina's water supply is classified as soft). And in hard-water areas, use of a liquid non-phosphate detergent will prevent problems with precipitation.

Association spokesmen maintain the ban would cost the average person \$9 per year in extra hot water, additives and

wear, while chemical removal at the waste treatment plant would cost \$8 per person. State officials say there would be little or no extra cost if the ban were imposed. The costs associated with wear could be eliminated with use of liquids and, officials say, non-phosphates are generally cheaper.

Jamie King, president of the Neuse River Foundation, an organization dedicated to upholding environmental quality in the Neuse River basin, says his organization is in favor of the ban.

for some answers," he says. "We're hoping Hans can tell us just how far we need to cut back."

Paerl says he is waiting on test results from this summer's bloom before making any statements about nutrient loads. But he says, "We're not talking about small excesses. We're talking a thirty to fifty percent excess of nutrients in the Neuse system. And it's probably been like this for the last fifteen to twenty years."

"The Neuse flows through one of the most populated areas of the state and one of the most highly developed agricultural areas. And every year there are more farmers, more people flushing their toilets and more industries. We

Photo by Nancy Davis



The bloom forms a scum that coats the surface

shouldn't be so surprised we're suddenly having blooms.

Everett says the DEM began monitoring the Neuse in 1978. Scientists studied nutrient levels, chlorophyll *a* levels, biomass of algae, algal species present and water parameters. They examined land-use in the basin and began analyzing the nutrient content of major point-source dischargers. Here are some of the things they learned:

- Average summer levels of chlorophyll *a*, an indicator of algal biomass, for the Neuse at New Bern have doubled since the early 1970s. The state water-quality standard is 40 micrograms of chlorophyll *a* per liter. This summer in bloom areas, levels were as high as 300 to 500 micrograms per liter in the water column and 1,700 micrograms per liter near the water's surface.

- Harvested cropland in the Neuse River basin increased approximately 30 percent from 1967 to 1980. A DEM report released this year indicated that agriculture contributed 40 percent of the nutrient nitrogen and 25 percent of the phosphorus released into the river.

- Census figures indicate that the urban population using centralized sewage treatment facilities increased by 29 percent between 1970 and 1980. The DEM report showed that 17 percent of the nitrogen and 42 percent of the phosphorus are discharged from municipal waste treatment plants.

- Forest and wetlands account for 20 percent of the nitrogen input and slightly less than 10 percent of the phosphorus input.

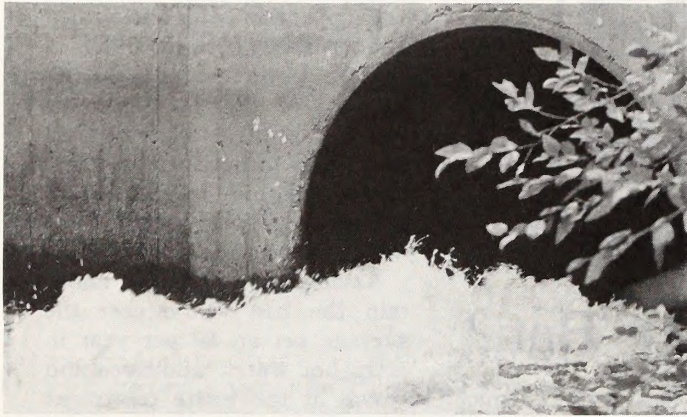
- Industry contributed four percent of the nitrogen and three percent of the phosphorus.

Continued on next page



- Six municipal dischargers (Durham-Northside, Raleigh, Wilson, Goldsboro, Kinston-Peachtree and New Bern) account for 95 percent of the estimated municipal phosphorus inputs and 81 percent of the municipal nitrogen inputs.

*Photo by Kathy Hart*



*Treated effluent flows from a waste treatment plant*

The 1983 General Assembly established a 10-member legislative committee that will continue to study the Neuse's problems. The legislative commission, with the technical assistance of state Department of Natural Resources and Community Development (NRCD) personnel, will prepare a Neuse River Action Plan by June 1, 1984, and a report for legislative action by February 1, 1985. Finally, it will produce a Neuse River Basin Water Quality Management Plan by May 1, 1986.

But some steps are already being taken to lower nutrient inputs into the river. The EMC will decide at its October 13 meeting whether to designate the upper Neuse, the portion of the river above the Falls Lake Reservoir, as nutrient-sensitive. Indications are that the commission will vote to apply the designation.

David H. Howells, a member of the EMC, says the commission chose to begin with the upper Neuse because proposed development around the Falls of the Neuse Lake was likely to increase nutrient input from urban run-off. The intended use of the lake for recreation and as Raleigh's water supply could be questionable if the lake became eutrophic.

Residents in the lower Neuse, who must live with the blooms, have long claimed that much of the problem originates upstream. Municipal waste treatment plants in the upper Neuse supply eight percent of the phosphorus released into the river, while the middle Neuse (from the Falls Reservoir to New Bern) releases 30.7 percent of the phosphorus.

DEM Director Robert H. Helms voiced the need at the EMC's August meeting for the entire Neuse basin to be classified as nutrient-sensitive. The commission endorsed the concept, but took no action to impose restrictions.

If municipalities are required to limit the nutrient input from their waste treatment plants, the costs will likely be passed on to the citizens, state officials say. "Right now there are no funds available at the federal or state level to aid the cities and counties with nutrient removal," says Lee Flemming, director of DEM's water quality section.

Nutrient removal at point source locations will be aimed

at removing phosphorus, which is easier and less costly to remove than nitrogen. And the majority of the phosphorus (as shown earlier) is discharged by known point sources which must abide by EMC decisions. Nitrogen, on the other hand, comes largely from non-point sources—agriculture, forestry, wetlands—areas beyond the control of the EMC.

One alternative to point source removal considered by state officials would be a ban on phosphate detergents and soaps (see inset, page 5). The EMC has recommended that the legislature enact a phosphate ban for 66 North Carolina counties. Six other states have enacted phosphate bans (one rescinded its ban).

While state officials are focusing on the point source removal of phosphorus inputs, they are also looking to agriculture and forestry for help in removing nitrogen. Since the EMC has no control over agricultural practices, nutrient limitations by farmers would be voluntary.

Maurice Cook, director of the state Division of Soil and Water Conservation, says implementation of "best management practices" (BMP) could go a long way toward reducing nitrogen input from farming (nitrogen comes largely from fertilizer). Best management practices include the implementation of conservation tillage, contour farming, filter strips, grass waterways, terraces, reduced fertilizer application rates and proper timing of fertilizer application.

"The main thrust of BMPs is to keep soil in the field," Cook says. "But reducing erosion also keeps the nutrients in the field and out of the rivers." Cook says his division, along



*Farm runoff carries heavy doses of nitrogen*

with the N.C. Agriculture Extension Service, is trying to educate the farmer in better use of BMPs.

According to Cook, the state is trying to initiate a cost-sharing program that would provide an economic incentive for farmers to implement BMPs. But Richard Barber, a member of the EMC, says the rising cost of fertilizer may be an incentive for using best management practices and less fertilizer.

The state would like for municipalities and county governments to take the lead in nutrient clean-up, Flemming says. But city and county officials from counties surrounding the upper Neuse told NRCD Secretary Joseph W. Grimsley in an August meeting that the state must be the enforcer in this problem. Only the state could ensure adequate, uniform controls, they told Grimsley.

—Kathy Hart



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



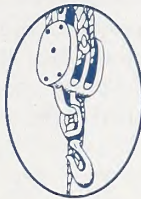
A fishing method — handed down from the Stone Age — is still putting fish on the table today. The method? Spearing. Today fishermen spear or gig flounder during the fall.

But unlike Stone Age men, fishermen today stalk their prey at night, using lights they can immerse under water. Fishermen gig flounder along the shallow edges of sounds, bays and creeks. Or, they work the beach, between the surf line and tide line. They use immersible lights to reveal the shadowy outline of a flounder hiding in the sand. The fisherman spots his prey and spears it.

Larry Giardina, the Sea Grant marine advisory agent at Bogue Banks, says it's important to spear the fish just behind the gills to save as much meat as possible. Once caught, the flounder are pushed up the metal gig and threaded onto a stringer. By placing the fish on the stringer and trailing them along in the surf, the fish can be kept alive during fishing.

The best times for gigging are one-and-a-half hours before and after low tide on a moonless night. For surf-gigging, choose a calm night when waves are less than one foot.

For more information about gigging flounder, contact the marine advisory agent nearest you. (Jim Bahen, Marine Resources Center/Ft. Fisher, 458-5498; Bob Hines or Larry Giardina, Marine Resources Center/Bogue Banks, 247-4007; Wayne Wescott or Rich Novak, Marine Resources Center/Roanoke Island, 473-3937.)



UNC Sea Grant and the South Carolina Sea Grant Consortium are sponsoring a longlining conference Nov. 2 at the Blockade Runner Motor Hotel in Wrightsville Beach, N.C.

The program, geared toward fishermen interested in longlining for snapper and grouper, will include sessions on the reef and bottom-fish resources, gear and fishing methods, and the economics of converting to longlining. Discussions will also include information on longlining for shark and the marketing of shark.

The day-long conference is sponsored in cooperation with the National Marine Fisheries Service's Beaufort Lab, the N.C. Division of Marine Fisheries, the N.C. Fisheries Association, the South Atlantic Fishery Management Council, and the S.C. Wildlife and Marine Resources Department.

To register, send \$7.50 (before October 19) or \$10 (after October 19) to Jim Murray, UNC Sea Grant, 105 1911 Building, North Carolina State University, Raleigh, N.C. 27650. For more information, call (919) 737-2454.

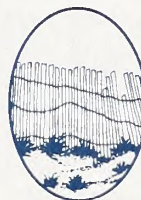


Jim Murray, director of Sea Grant's Marine Advisory Service, and Jeff Johnson, of the Institute for Coastal and Marine Resources at East Carolina University, have received a grant from the National Marine Fisheries Service's Southeast Regional Office to develop a program to increase the demand for underutilized species among marine recreational fishermen.

The National Marine Fisheries Service estimates that over 30 percent of the total poundage of finfish harvested for food is caught by recreational fishermen. Often these fishermen seek the same species of fish as commercial fishermen, while other, under-used species go unharvested.

In the first year of the study,

Murray and Johnson will be developing a program to educate the public about the merits of underutilized species in the waters from Texas to North Carolina. They hope they can make species such as sea catfishes, dogfish and toadfish as sought-after as striped bass, bluefish and flounder.



If you're thinking of selling some coastal property and you're concerned about how the land will be used, there's something you can do about it. Walter Clark,

Sea Grant's coastal law specialist, says that property owners can protect the aesthetic and environmental qualities of their land by using several non-regulatory devices that will impose limitations on the future use of the land.

Suppose a coastal developer owns a large tract of land that includes a maritime forest—a forest that he'd like to protect. Clark says the developer, in subdividing his property, might include restrictive covenants in each of the deeds to protect the forest.

Clark says that towns and counties also have other options, such as conservation easements, to protect the future use of property. For more information, write Clark at 105 1911 Building, North Carolina State University, Raleigh, N.C. 27650 or call (919) 737-2454.

Is the estuary's role as a nursery more important than its role as an outlet for water drained from agricultural fields? Resource managers can only vaguely estimate the answer.

But John Miller, a zoologist at North Carolina State University, and Steve Ross of the N.C. Division of Marine Fisheries, are working on a way to help managers make such decisions easier. Using mini-grant funds awarded by Sea Grant Director B.J. Copeland, the researchers will compile an extensive bibliography of estuarine research. They will be looking

*Continued on next page*



primarily at research that estimates the habitat value of estuaries as nursery areas for juvenile fish and shellfish. The team will draw extensively on data collected by the Division of Marine Fisheries, which has been sampling fish and shellfish, and studying water parameters, in the state's estuaries since 1972.



In its September meeting, the N.C. Marine Science Council selected a task force to establish a marine and coastal policy for North Carolina. The task force

will examine three aspects of North Carolina's policy: the state's role in the state-federal partnership that manages coastal and marine resources, the state's influence on national ocean policies, and the state's role in international ocean policies, particularly in respect to trade and technology.

Sea Grant Director B.J. Copeland was appointed to the task force, along with William Queen, Director of the Institute for Coastal and Marine Resources at East Carolina University (ECU), and coordinator of Sea Grant's estuarine research, and Michael Orbach, an expert in ocean policy at ECU and a Sea Grant researcher.



Raking the ocean floor for fish may net a few North Carolina fishermen more than they bargained for. Occasionally fishermen come up with an old torpedo or other explosive ordnance left behind after military training exercises, sea dumps and combat operations. But if handled and disposed of properly, explosives can be of little or no danger to fishermen.

For information about the identification and safe disposal of explosive ordnance, write for the free Sea Grant publication, *A Fisherman's Guide to Explosive Ordnance*, 105 1911 Building, North Carolina State University, Raleigh, N.C. 27650. Ask for UNC-SG-81-05.

Lifting nets and pulling pots can be backbreaking work for the small-boat fisherman, who often works alone. But fishermen can prevent aching muscles and save valuable time by installing hydraulic equipment to do the job for them. Hydraulic systems, which are simple to use, can power many types of fishing equipment.

For more information about hydraulics, write for the free Sea Grant publication, *Hydraulics: Handy Helpmate on Small Fishing Boats*. Ask for UNC-SG-75-19.

The Mid-Atlantic Marine Education Association Conference will be held at the Marine Resources Center at Bogue Banks, October 21 and 22. Workshops, field trips, papers and programs will center on the conference theme, "barrier islands and people."

Lundie Spence, Sea Grant's marine education specialist, will present a program using Sea Grant educational materials developed to teach children about hurricanes.

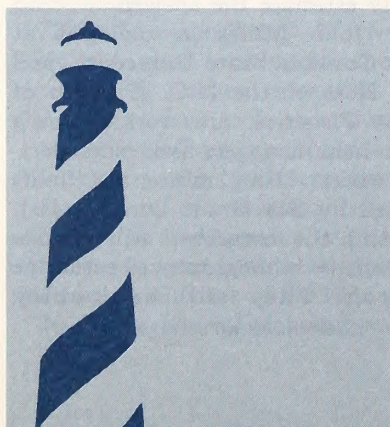
The conference is expected to draw educators from five states (educators do not have to be members of the association to attend). For more information about the conference, call Mark Joyner at the Marine Resources Center at Bogue Banks (919/247-4003).

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# COAST WATCH

National Marine Fisheries Service Photo

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Menhaden





Fertilizer, lamp oil, lipstick, chicken feed and margarine—an unlikely combination of products, but all derived from the same source. Menhaden. This bony, oily fish fertilized Pilgrim farm-

land. And since those times, the nation's largest fishery has seen a lot of change. Oil is no longer extracted from the fish in boiling kettles. Purse seines replaced gill nets and haul seines. Steel, diesel-powered vessels ply the same waters once fished by wooden schooners and steamers. Power blocks and winches replaced the muscle and the song of man.

But the menhaden can't always be found in the same huge numbers they once were. Some say North Carolina fishermen are catching too many small menhaden. But North Carolina processors are worried that strict regulations may put them out of business.

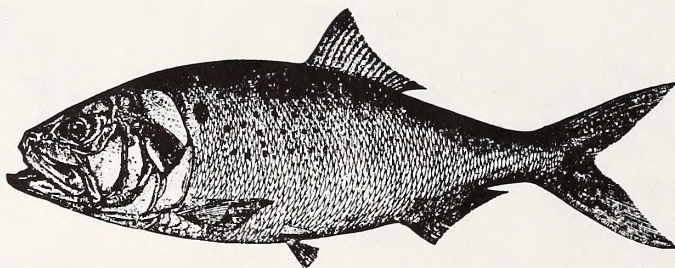
This month, *Coastwatch* takes a look at the menhaden fishery in North Carolina.

Menhaden today. Pogies, mossbunkers, bunkers, alewives, whitefish, bonyfish, fatbacks and shad to those who have fished for menhaden from Maine to Florida during the fishery's 300-year history.

Menhaden have collected more than 30 common names. In North Carolina, they've most often been known as fatbacks, shad and pogies. Scientifically, their names are *Brevoortia tyrannus*, the Atlantic menhaden, or *Brevoortia patronus*, the Gulf menhaden (the two species sought by fishermen). But no matter what you call them, all the names apply to the same bony, oily fish.

In a book written a century ago, George Goode aptly described the menhaden's ecological niche: "It is not hard to surmise the menhaden's place in nature: swarming our waters in countless myriads, swimming in closely-packed unwieldy masses, helpless as flocks of sheep, close to the surface and at the mercy of any enemy, destitute of means of defense or offense, their mission is unmistakably to be eaten."

Sharks, whales, striped bass, bluefish and countless other fish seek out the menhaden for their next meal. Bluefish slash and kill thousands of fish in a single, ruthless attack. Occasionally, bluefish will chase schools of menhaden into shallow surf, where they become stranded and die on the beach. And schooling, the menhaden's one defense against natural enemies, is their undoing with fishermen.



## Bunker Biology

With so many predators, how does the menhaden survive? Prolific reproduction. An individual female may spawn from 40,000 to 700,000 eggs each year.

Along the mid-Atlantic, the spawning occurs in late fall and winter over the continental shelf. Once the eggs are fertilized and

hatched, currents sweep the young menhaden to the estuary. Juvenile menhaden spend about eight months in the estuary before leaving in the fall.

From May to October, Atlantic menhaden one year old and older are stratified by age and size along the Atlantic Coast. The older and larger fish are found in northern waters, while the younger, smaller fish remain to the south.

As fall approaches, the larger menhaden begin a southward migration that culminates in the congregation of all fish south of Cape Hatteras by early winter. In late December or early January, the schools disappear. It is uncertain where the menhaden overwinter, but many scientists believe it's in deeper, more offshore waters.

As filter feeders, menhaden swim with their mouths agape, swallowing tiny organisms in the water. These fish have no teeth. An angler could cast all day in a school of menhaden without a single nibble.

By feeding itself, menhaden frequently feed a crab-like parasite, which makes its home in the menhaden's mouth. Fishermen call the parasites "bugs"; hence the name bugfish has joined the list of menhaden names.



# Of purse seines and spotter planes

Every American school child knows the story of how the Indian Squanto saved the Pilgrims from starvation by showing them how to fertilize their crops with fish. This fish was probably Munnashatteaug, a word meaning fertilizer. The English pronounced it menhaden.

Historians have long believed the Indians taught America's colonists how to fertilize fields with fish. But a New York anthropologist raised some doubt in a 1975 article in *Science* magazine. The anthropologist suggested that Squanto, who had been kidnapped and taken to Europe, may have learned about the value of fish as a manure from the English.

But whether the practice was European or Indian, it was soon common for New England farmers to manure their fields with menhaden and other fish. As bait, menhaden were used to catch haddock, cod, mackerel and other fish.

And early American historians say that menhaden were eaten as food. John Lawson's *History of North Carolina*, written in 1714, called fatbacks (one of the many names for menhaden, see story, page 2) an "excellent sweet food." And Sir Walter Raleigh's Roanoke Island colony is believed to have dined on menhaden.

During the 1700s and 1800s, menhaden were salted and eaten like herring, says John Reintjes, a fisheries biologist, who spent 25 years with the National Marine Fisheries Service studying menhaden and other fish. Menhaden were considered a poor man's food or famine food in the Carolinas, Reintjes says.

"It's a bony fish, but it's the best tasting fish in the ocean when it's fresh," says 77-year-old Berkeley Simpson of Beaufort, a man who spent 42 years aboard a menhaden boat. "You split 'em, salt 'em and dry 'em awhile. Then you cook 'em over charcoal."

Menhaden roe has long been considered a delicacy. Stripped from the large mammy shad, also called roe shad, during the fall runs, the roe is salted and fried. During World War II, E.W. Copeland of Morehead City tried canning the roe, but couldn't meet the demand because of erratic availability.

During the early 1800s, fishermen discovered the value of menhaden oil as a substitute for whale oil in lamps, paints and tanning solutions. At first, the fish were allowed to rot in barrels, and the entire contents were pressed in hogsheds so the oil would rise to the

surface. Eventually steam cooking replaced the rotting process and, during the 1850s, the mechanical screw press was introduced.

During the Civil War, a greater demand for menhaden oil spurred the fishery to expand rapidly. Before the war, menhaden were caught only in the North. But Union soldiers stationed in North Carolina noticed the abundance of menhaden in in-shore waters. When they returned home with the news of the bounty, several opportunists traveled south to cash in on this oily wealth.

But all efforts to establish a fishery in North Carolina between 1865 and 1887 failed. George Goode and Howard Clark wrote in an 1887 report that it was doubtful a fishery could be established in this state. They cited problems with spoiling catches, fickle inlets and shallow sounds.

But just two years after the Goode and Clark report was published, the menhaden fishery had begun to thrive in this state. By 1889, seven factories were operating near Beaufort. And by the turn of the century, the fishery had expanded to include plants near the Cape Fear River. During the 1902 season, more than 18 million pounds of menhaden, valued at over \$30,000, were caught in North Carolina.

When the fishery moved south, it brought with it some northern innovations. One of those, the purse

*Continued on next page*

*N.C. Division of Archives and History Photo*



*An 1889 catch of menhaden from the Albemarle Sound*



seine, developed in the 1830s, allowed fishermen to net large quantities of fish. Before development of the purse seine, fishermen caught menhaden in gill nets or haul seines they worked from the beach.

A purse seine is a large "curtain" type net, hung between surface floats and weights along its base. Two boats, called purse boats, drop the net in a circle. When a school of fish is enclosed, a heavy weight called a "tom" is attached to the purse line and dropped overboard. The purse line is then pulled in, causing the bottom of the seine to close like a purse.

Sailing sloops and schooners were the first boats to

use purse seines to catch menhaden; purse boats were oar-driven yawls. After the Civil War, coal-fired steamers were introduced and, during the 1930s, diesel-powered vessels began to replace steamers.

"The first boat I worked on when I started working in 1929 was a diesel," says Simpson. "They were small boats, only held about 300,000 to 400,000 pounds. We didn't go out far, to Hatteras or Frying Pan Shoals. And we came in every night because the boats weren't refrigerated then and the fish would spoil."

Simpson started work as an engineer aboard his first boat and within two years made captain. "We used to spot schools from the masthead," he says. "We might run all day without finding a school. We looked for a dark spot or a ripple on the water. When we found a school, we dropped the striker off and put him on the fish. Then we dropped the purse boats and the striker guided the boats to the school."

The men in the purse boats would set the net, then begin hauling it in by hand (see chantey story, page 6). As more and more of the net was hauled aboard the purse boats, the fish were compressed into the butt of the net. Then the large boat, called the mother ship, would come alongside the net and the purse boats would form a triangle against her side. A large dip net was used to scoop the fish out of the purse net and into the ship's hold.

"If we had a fast crew and the catch wasn't too big, we could get the fish on the boat in half-an-hour," says Nathaniel Jackson of Beaufort. Jackson worked his way from cook to captain during his 50 years of working menhaden boats from New York to Texas. "All the work was done by hand when I first started working on the boats. It was a back-breaking job, but I wouldn't have done anything else."

Simpson says that if the set was a large one crews from other boats would help to pull in the net, even if they worked for another company. "But even with



N.C. Division of Archives and History Photo

*An early steam-powered fishing boat plys the waters in search of menhaden. Steam-powered vessels replaced sailing sloops and schooners shortly after the Civil War (above).*

*Before purse seines, fishermen used haul seines like the one at right to catch menhaden. During this big haul at Sutton's Beach along the Albemarle Sound, everyone turned out to help.*





the extra help, lots of times we would bust a net. A cotton net just couldn't hold as much weight as the nylon ones do now," he says.

By the time Simpson was working the menhaden boats, the fish were no longer being used for fertilizer. During the turn of the century, the dried fish scrap was being mixed into feeds for poultry, swine and cattle. Menhaden oil was used in the manufacture of soaps, paints, linoleum and waterproof fabrics.

Following World War II, the industry grew rapidly and reached peak production between 1953 and 1962. By then, spotter planes were used to sight the "purple" schools of menhaden from the air. Nylon nets replaced cotton nets. Pumps sucked the fish from the nets through hoses to the hold. And hydraulic power blocks winched aboard the nets.

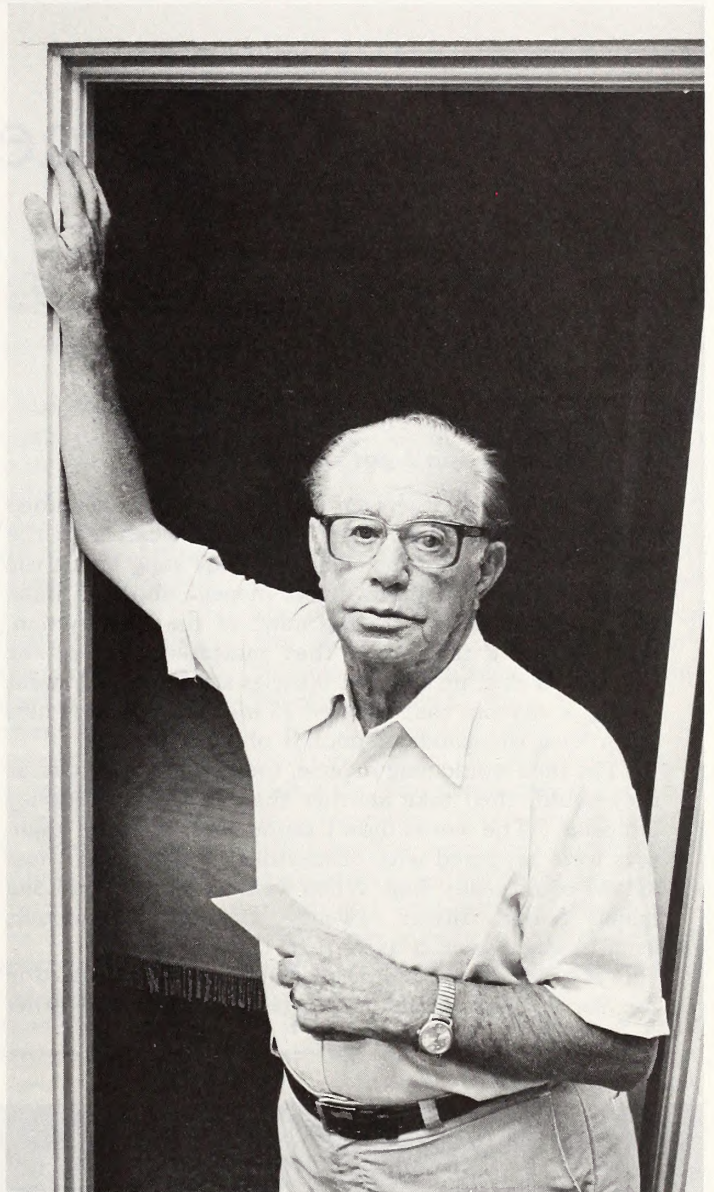
In 1961, eight menhaden plants were operating in North Carolina, most of them in the Morehead City/Beaufort area. During North Carolina's fall fishery, which lasted from mid-October until December, menhaden boats crowded into Beaufort, many hailing from northern states.

"They'd have a big parade in Beaufort when the boats came back during the fall," says William E. Edwards, manager of Standard Products' North Carolina plants. "There'd be 50 menhaden boats tied up along Front Street. The boats bought their groceries here, their fuel here. The people of Beaufort were glad to see us."

But after 1962, sharp declines in catches closed several factories and reduced fleets in North Carolina. The fishery stabilized during the early 1970s, but never recovered its former production. Substantial catches in the Gulf of Mexico fishery, begun during early 1900s, had drawn most of the big companies southward, taking with them some of the Carteret County families who worked in the fishery.

—Kathy Hart

Photo by Scott Taylor



N.C. Division of Archives and History Photo



*Berkeley Simpson, above, captained a menhaden boat for forty years. He remembers the days of striker boats, cotton nets and chanteys.*

*This 1884 photograph, at left, shows an old menhaden scrap-and-oil factory near Beaufort. Today, menhaden are pressed, dried and ground into chicken feed. The oil is extracted and shipped to Europe for use in margarine.*



# To hear the men sing

*Chanteyman:*

*I left my baby standin' in the back door cryin',  
Honey, don't go!*

*Fishermen:*

*Lawd, lawd, don't go!*

*Chanteyman:*

*I'd go home but ain't got no money!*

*Fishermen:*

*Lawd, lawd, ain't got no money!*

The menhaden fishermen sang. In unison, menhaden fishermen heaved their nets, heavy with catch, to the rhythm of their song or chantey. They sang about the women they left behind, about money, about a mule, about whatever came to the mind of the chanteyman. But it wasn't the words that mattered; it was the rhythm—a rhythm that set muscles straining and sweat rolling, a rhythm that enabled 25 men to “harden” nets laden with thousands of pounds of menhaden.

“The men would sing a verse, then pull just as hard as they could, then take another chantey,” says Berkeley Simpson. “The words didn't sound too good (the chanteys were peppered with obscenities), but some of those fellows could really sing. When we were working in Long Island Sound, fifteen, twenty, twenty-five sailboats would gather around us to hear the men sing.”

It is believed that the menhaden chanteys originated in the South, most likely in North Carolina. Like other

Hampton Mariners Museum Photo



work songs, they provided the rhythm to coordinate the efforts of the workmen. Today no song is heard from the men working the purse boats. Instead it's the hum of motors, winches and hoses, doing the work done twenty years ago by the muscles of men.

Only a few recordings of the chanteys were made; most of the colorful chanteys will be lost as the fishermen who sang them die. A few of the chanteys (the above included) can be found in John Frye's book, *The Men All Singing*.

Photo by J. Foster Scott



*The mother ship waits as two purse boats make the final set of the day off the beach at Rodanthe*



# Atlantic fishery faces hard times

Last year, fishermen from Maine to Florida landed over 382,000 metric tons of Atlantic menhaden. These catches, combined with those from the Gulf, make menhaden one of the country's largest fisheries. But the statistics don't tell the whole story. While the menhaden fishery is one of the most productive in the nation, it's also one of the most troubled.

Consider the evidence. In 1956, 712,000 metric tons of Atlantic menhaden were landed by purse seine. In 1969, the fishery bottomed out at 161,000 metric tons. While the catch increased in 1972 to 363,000 metric tons, it decreased again in 1973 and 1974. Since then, landings have gradually increased, but have never reached the "peak" set in 1956.

Large fluctuations like these have fisheries biologists worried—could the bottom drop out again? Probably not, they say. But, they add that we need to have a management plan for Atlantic menhaden.

Up until the mid 60s, the catches were composed of older, larger fish. Then the larger fish suddenly disappeared. Maybe environmental conditions were bad. Maybe overfishing drove the numbers down.

In 1982, the Atlantic States Marine Fisheries Commission (ASMFC) recommended some regulatory actions intended to protect the younger fish so they could contribute to the catch in later years.

The proposed regulations were:

1. Regulating the mesh size of the purse seine, with different mesh sizes for different parts of the coast.

2. Closing a one-mile corridor off the beaches from Cape Henry, Virginia to Cape Fear in North Carolina.

3. Reducing the fishing season by varying amounts along the coast. Under the proposal, menhaden fishing in North Carolina would be prohibited after mid-December.

Implementation of the proposals is voluntary. The states have jurisdiction in waters out to three miles—the area in which most menhaden are caught. The N.C. Division of Marine Fisheries decided the proposals for regulating the mesh size and for closing a corridor needed more study.

Influenced by the findings of a study by Sea Grant researcher Vito Blomo, the Division of Marine Fisheries decided not to implement the recommended shortened season in North Carolina. (Blomo has begun a second Sea Grant study on the impacts of a closed corridor.) So far, New York and New Jersey are the only states to implement the dates for a shortened season in their area.

Bob Mahood, Director of the Division of Marine Fisheries and a member of the Menhaden Management Board of the ASMFC, says there was a trade-off involved in that recommendation. "Biologically, the Division of Marine Fisheries felt that proposal was valid.

But the socio-economic impacts may outweigh the biological."

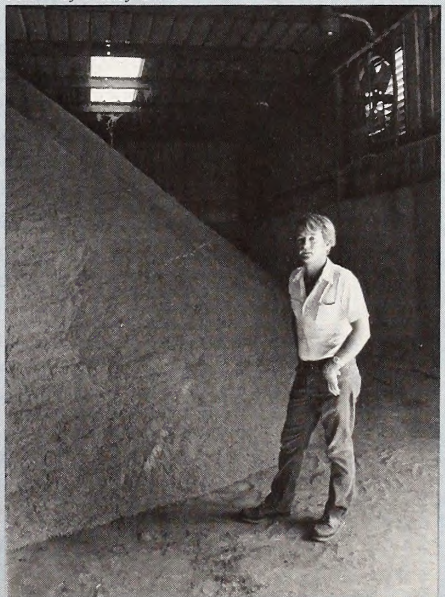
Blomo's study confirmed that trade-off. He found that it was more than a problem of managing fish. He studied the socio-economic impacts of a shortened menhaden season and found that the people who make their livings in the industry could suffer. (Blomo's findings are published in Sea Grant Working Paper 83-4.)

Blomo estimates that, during the first five years of the shortened season, North Carolina companies could face a 20 percent loss. (Biologists estimate it will take five years for the menhaden population to adjust to the new fishing pressures.) And, even if those companies were able to survive that initial period, the permanent loss would likely be five to six percent.

Blomo says that shutting a plant down, even for a short time, would be too costly. He estimates that about half of a company's operating costs are

*Continued on next page*

Photo by Nancy Davis



*"There have been a lot of years when there wasn't any fishing until the fifteenth of December."*

*—Billy Tickle*



fixed. Even if there is no fishing, the companies would have to pay those costs.

North Carolina fishermen oppose the recommended shortened season. Here, the season is divided into the summer fishery and the fall fishery. Beginning in late November or early December, large schools of menhaden migrate south and gather off the North Carolina coast, concentrating in December (see biology story, page 2). North Carolina is the only state with a fall fishery. In the past, the December

and January catches have accounted for a large portion of the annual catches. But recently, most of the catches have been composed of "peanuts," menhaden less than six inches. Fisheries biologists are concerned that not enough small fish will reach the spawning age.

Billy Tickle, general manager of Sea and Sound Processing Company in Beaufort, says the industry is already economically shaky and a shorter season would mean disaster for his company. "It would destroy us down

here. There have been a lot of years when there wasn't any fishing until the fifteenth of December."

Jule Wheatly, president and general manager of Beaufort Fisheries, agrees with his competitor. "The bulk of our fishing is in mid-December. Unfortunately, the fish just don't read regulations; Mother Nature is the main controller in our industry. Some companies are hanging on by a thread. I don't think North Carolina is going to sell us down the river to help the fishermen in New Jersey."

# Menhaden—food for tomorrow

*Photo by Cassie Griffin*

Menhaden—known for years as a trash fish, the poor man's fish, an industrial fish—may be on its way toward an improved image. Tyre Lanier, a Sea Grant researcher in the NCSU Food Science Department, says menhaden may become the soybean of the sea.

At the turn of the century, soybeans were used mainly for animal feed, says Lanier. Now, the protein from soybeans can be found in many items on the grocer's shelves. And, Lanier predicts a similar future for the lowly menhaden.

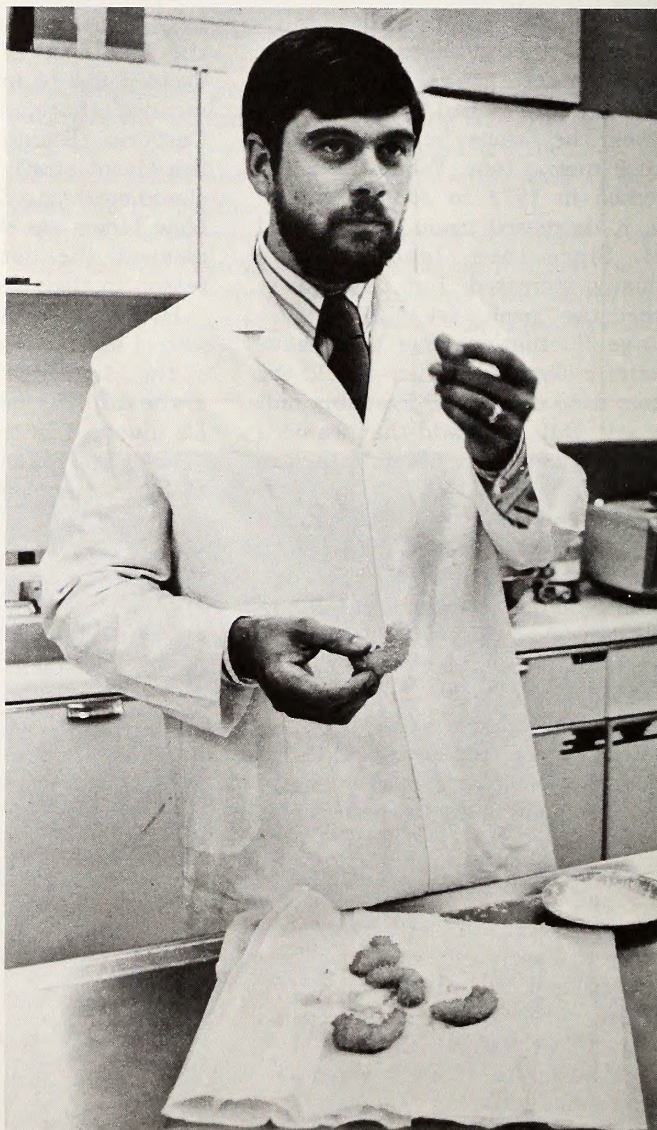
He's been experimenting, mincing menhaden to make surimi, a product developed by the Japanese. By water-washing the mince, the Japanese end up with a protein concentrate suitable for use in restructured seafood products. For the consumer, Lanier's research could mean a fish product high in food value but low in cost.

"Nutritionally, surimi is far superior to soy," says Lanier. "And, functionally, it's much better than soy. It has a bland flavor so that other flavorings can be added." One of the problems with soy is the "beany" flavor that it contributes to the product.

The surimi process transforms the bony, fatty menhaden into an edible fish. A mechanical deboner removes the bones, and all but two percent of the fat is removed during the washing process. Along with the fat goes the strong, fishy taste characteristic of menhaden.

The surimi process uses only 20 percent of the fish. The remainder of the fish could still be used for fish meal and fish oil. Lanier says there's already a large, well-established industry equipped to handle the by-products of the surimi process.

If menhaden were used to make a food for human consumption, processing plants would have to upgrade their equipment and impose rigid sanitation conditions. Lanier suggests that two boats, one for food fish and one for feed fish, would operate on the fishing grounds. Some of the catch would be pumped onto each boat. From then on, the processing would be separate until the waste from the surimi would be pumped back into fish meal and solubles processing.



*Tyre Lanier samples a surimi product*

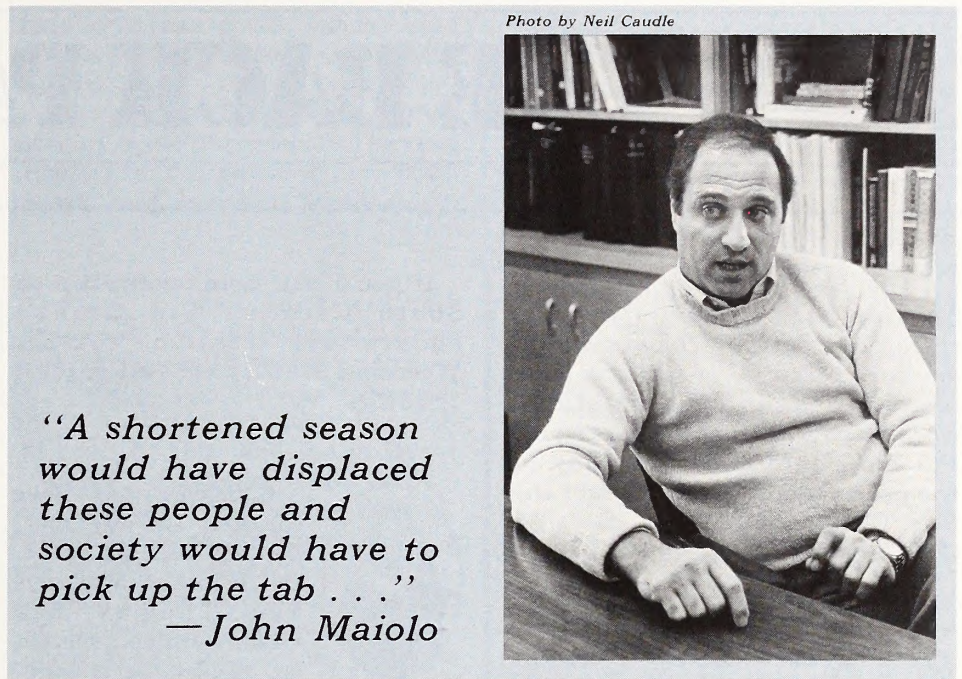


For North Carolina fishermen, a shortened season could mean a loss of most of their incomes. Their earnings are tied to the amount of fish they catch. If a shorter season means fewer fish, it also means fewer dollars in the pockets of fishermen.

Many of the workers that would have been affected are black. John Maiolo, a Sea Grant researcher and sociologist at East Carolina University, assisted Blomo with the sociological aspects of the study. Maiolo says that blacks have traditionally been excluded from the "glamour" fisheries, such as shrimping, because they lacked the capital and the connections necessary to market their catch.

"For poor whites and for blacks, menhaden fishing has offered an opportunity to make money. In a good year, a fisherman could make as much as \$20,000 for six months of work," says Maiolo.

"A shortened season would have displaced these people and society would have to pick up the tab, either in the form of training for new jobs or welfare payments. The economy is poor, there aren't many unskilled jobs around, and they don't have the background for an eight-to-five job," says Maiolo.



*"A shortened season would have displaced these people and society would have to pick up the tab . . ."*  
—John Maiolo

A shorter season in North Carolina could eventually improve the fishing in northern states. National Marine Fisheries Service tagging studies illustrate the stratification of the fish by size along the coast. The older, larger fish migrate farther north. Robert Chapoton has spent 20 years with the

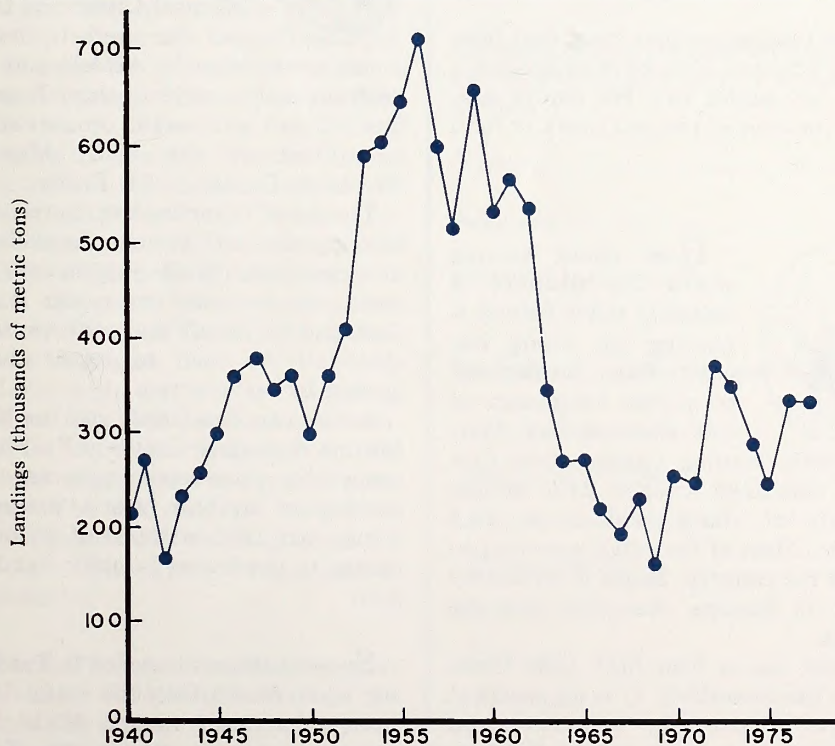
federal research program for menhaden. He says reaction from North Carolina fishermen is not surprising. "If you save a fish from North Carolina, it will be in Virginia or maybe in New Jersey in the next two or three years."

But Chapoton says National Marine Fisheries Service wants to ensure that there's no immediate danger to the stocks of menhaden and to improve the long-range stability of the fishery. "The whole coast would do better if we reduced the catch of the younger fish now and let them become older fish."

The decision not to shorten North Carolina's menhaden fishing season doesn't please fishermen in the North. They say North Carolina fishermen are catching the fish that would eventually migrate north. On the other hand, North Carolina menhaden fishermen say they'd have nothing to catch if they left the peanuts in the water.

But, North Carolina is a key state, says Paul Perra, Interstate Fisheries Program Coordinator with the Atlantic States Marine Fisheries Commission. "North Carolina is the state fishing the small fish. They're taking the peanuts and excluding those fish from the rest of the industry and from future years. By not going along with the plan, North Carolina stopped the interest of the plan. If the state doesn't comply, the plan will be useless."

—Nancy Davis



Graph illustrates fluctuations in menhaden catches



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



There are thousands of acres of old rice fields in South Carolina and much of that impounded land hasn't been used in 70 or 80 years. But researchers with the South Carolina Sea Grant Consortium are studying the feasibility of using that old agricultural land for aquaculture.

They're flooding the abandoned rice paddies, then allowing Mother Nature to stock and feed the crop. Fields that once produced rice are now yielding 40 or 50 pounds of shrimp per acre.

Jack Whetstone, marine extension specialist with the South Carolina Sea Grant Consortium, spoke to aquaculture experts and advisory personnel at UNC Sea Grant's aquaculture project in Aurora on October 10. Whetstone told the group that shrimp are just one species that shows promise for aquaculture. In freshwater impoundments, they've been able to grow crawfish, establishing a new industry in South Carolina. This year, about 525 acres will be farmed in the production of crawfish, and Whetstone estimates that each acre will produce 1,000 pounds.

Whetstone says aquaculture in his state will be similar to truck farming. There will be a variety of species cultured in a variety of environments. And aquaculture won't be limited to the coast. In the central part of the state, soybean farmers have been successfully raising freshwater shrimp. "They say they're making more money per acre off shrimp than they are off of soybeans," says Whetstone.

If you'd like more information on South Carolina Sea Grant's aquaculture research, contact Whetstone at (803) 546-4481 or (803) 795-8462.



Chickens may have cornered the egg market, but fish eggs, or roe, can be just as tasty, says Sam Thomas, Sea Grant's seafood specialist. Mullet roe is popular with coastal Carolinians, he says. In late October and early November, the fish begin a fall run along the North Carolina coast as they head south to spawn. Fishermen who catch the mullet extract the egg sac containing the eggs from the fish.

Coastal cooks roll the roe in salt, press it between two planks for about 24 hours, then wrap it and freeze it for later. For cooking, Thomas recommends baking or frying without a batter.

Don't expect to love your first bite, warns Thomas. You have to acquire a taste for mullet roe. He enjoys nibbling the cooked roe as a snack or for a meal.



How about serving shark for dinner? A fledgling shark fishery is gearing up along our coast. But a lot depends on public acceptance of this shunned fish. During 1982, landing figures show that U.S. fishermen caught 24.6 million pounds of shark, valued at \$4.8 million. Most of the catch was shipped out of the country. Shark is commonly eaten in Europe, Australia and the Orient.

Shark has a firm flesh that tastes much like swordfish. It is an excellent source of protein, vitamins and minerals. And shark can be cut into steaks or fillets.

But shark must be handled properly

at sea if it is going to be tasty on the table. A shark should be bled soon after being caught, because its blood contains urea, which can alter the taste of the meat as it deteriorates. A properly handled shark can have a shelf-life of 18 days.

"I have no doubts that, if there is some quality control put onto shark, that sooner or later it'll become readily accepted," says Pete Whiting of Ottis Fish Market in Morehead City. "Grouper, years ago, was thought to be a trash fish. And now all the finest restaurants serve grouper."

Whiting says he would like to see shark sold in supermarkets for just over a dollar a pound—making shark a better buy than hamburger.



The Christmas tree that decorates your home during the holidays, can be the base of tomorrow's sand dune. Natural Christmas trees can be used to repair dunes worn down by vehicle and pedestrian traffic, says Spencer Rogers, Sea Grant's coastal engineering specialist at the N.C. Marine Resources Center at Ft. Fisher.

The trees' branches help to trap the blowing sand and become the skeleton of a new dune. While Rogers says the trees can be used to repair dunes damaged by people and vehicles, trees shouldn't be used to repair dunes eroded by wave action.

Each year, Sea Grant and the N.C. Marine Resources Center at Ft. Fisher sponsor a dune-repair program. To participate in this year's program, bring your tree, stripped of its ornaments, to the center January 1 at 2:30 p.m.

Spencer Rogers traveled to Texas to see what North Carolina could learn from a hurricane named Alicia. The hurricane, which struck the Texas coast September 18, was classified as a minimal category three storm



(category one is the mildest storm and category five is the most fierce).

Rogers says most of the damage to homes and buildings was caused by Alicia's 110 mph winds, moderate by hurricane standards. He estimates that in small coastal towns as many as 75 percent of the buildings received substantial damage. And the damage resulted not just from the strength of the winds, but also from poor construction techniques, he says.

"Most of the failures that we looked at were due to poor connections between the roof, the rafters and the side walls, and the side wall connections down through the floor beams and joists," he says. "After viewing the damage we learned you can't emphasize enough the importance of good connections in coastal construction."



Seafood may be on its way to the baby-food shelves. Laura J. Mackintosh, a master's student in food science at NCSU, has completed initial research on a project, funded jointly by Sea Grant and the National Fisheries Institute, that will develop a baby food made out of seafood.

So far, there are no baby foods that use fish as a main ingredient. But Mackintosh has already developed a meat stick using surimi, or minced fish, made for toddlers from sea trout. Mackintosh says the product proved acceptable in nutritional, textural and sensory qualities. Frank Thomas, extension professor in Food Science at NCSU and Mackintosh's adviser, presented the results of her work at the Atlantic Fisheries Technological Conference in August.

Mackintosh says she is continuing work on fish chowders and meat dinners for toddlers, and also on the strained version of these products for infants. The final results of her project will be presented next August at the Atlantic Fisheries Technological Conference.

Frank Thomas, who is also project director for Sea Grant's work at the NCSU Seafood Laboratory in Morehead City, has been chosen as the 1984 chairman of the Atlantic Fisheries Technological Conference.

The conference is an annual open forum on technological progress in the fisheries.

Joyce Taylor, Sea Grant's marine advisory agent at the lab, will serve as secretary for the conference, which will be held next August in Wilmington.



Sea Grant researcher Wayne Skaggs will speak to the annual meeting of the National Association of State Universities and Land-Grant Colleges (NASULGC) in Washington, D.C., November 15. Skaggs is one of three scientists who will address a symposium for university and college administrators about the problems of land use near estuaries. NASULGC recently created a marine division to go along with its agriculture and urban affairs divisions.

Skaggs will explain his Sea Grant research into agricultural drainage in North Carolina's coastal zone. Skaggs and researcher Wendell Gilliam are developing a mathematical model to predict the amount of drainage into estuaries from farmland as a function of land activities and rainfall.

State Senator Melvin R. Daniels Jr. of Elizabeth City has been elected chairman of the South Atlantic Fishery Management Council. Daniels has served four years as a Council member and was vice-chairman of the Council last year.

The South Atlantic Fishery Management Council develops and monitors management plans for the fisheries from the territorial waters of North Carolina, South Carolina, Georgia and Florida's east coast out to the 200-mile limit.



Jerry Schubel, director of the Marine Sciences Research Center at the State University of New York at Stony Brook, will travel to North Carolina December 5 and 6 for a series of seminars and lectures. Schubel, an internationally renowned oceanographer, has extensively studied pollution problems in the New York and Long Island Harbors and waste disposal in the New York Bight.

He will present a seminar at the In-

*Continued on next page*

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, 105 1911 Bldg., NCSU, Raleigh, N.C. 27650.

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Coastal property owner ☐ yes ☐ no Boat owner ☐ yes ☐ no



stitute for Coastal and Marine Resources at East Carolina University December 5, then travel to Raleigh where he will meet informally that evening with North Carolina State University students. On December 6, Schubel will speak to an NCSU interdisciplinary "Oceans" class, taught by Lundie Spence, Sea Grant's education specialist.

If you would like to arrange a time to talk with Schubel, contact the Sea Grant office in Raleigh at 737-2454.



If you own beach-front property that is subject to erosion, you're probably hesitant to build on it. But Walter Clark, Sea Grant's coastal law specialist, says your land may still be worth something.

In its 1983 session, the North Carolina General Assembly passed a law that allows a tax credit for land donated to the state, a local government or to a conservation organization. Clark says you'll be giving yourself a tax credit and providing the public with access to natural resources.

Clark says the land must be in North Carolina and must be useful for public beach use, public access to public waters or trails, fish and wildlife conservation or similar land-conservation purposes. The N.C. Department of Natural Resources and Community Development will determine if your property is suitable for those uses.

The amount of the tax credit is limited to 25 percent of the value of the donated land, up to a \$5,000 maximum, says Clark. For more information, contact Clark at UNC Sea Grant, 105 1911 Building, North Carolina State University, Raleigh, N.C. 27650.



It looks like a miniature crab pot, but it's really a shrimp trap. Jim Bahen, the Sea Grant marine advisory service agent at Ft. Fisher, is experimenting with the trap to see how well it works. The traps have been used along the Gulf Coast and in Maine, but never in North Carolina.

The trap is a 16-inch cube made of fine wire mesh. It has two side openings, a central bait well and two passages to the main body of the trap.

Bahen has been experimenting with different baits—fish meal, commercial catfood, cornmeal and fish pellets—to see which works best. He's learned that a combination of catfood and fish meal attracts the most shrimp. Bahen estimates the trap will catch up to two pounds of shrimp per night. And he says the trap seems to catch more brown shrimp than white shrimp.

Like crab pots, the traps are placed in shallow water, away from areas with a strong tidal flow. By using the traps, fishermen could fish areas they are unable to reach with trawls.

But Bahen cautions that no rules have been established and any fishermen wishing to purchase a trap should

check with his local fisheries enforcement officer.



Leon Abbas, Sea Grant's marine recreation specialist, has written a publication to help marina operators manage their fuel inventories. The booklet offers

a simple procedure to determine how much fuel to order and when to order it.

For a copy of *How to Manage Your Marina's Fuel Inventory*, write UNC Sea Grant, 105 1911 Building, North Carolina State University, Raleigh, N.C. 27650. Ask for UNC-SG-83-04.

*Sea Grant in North Carolina, 1981-1982*, by Neil Caudle, Kathy Hart and Nancy Davis, is a biennial report of Sea Grant research, education and advisory service activities. For a free copy of the 46-page report, write UNC Sea Grant. Ask for UNC-SG-83-05.

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# COAST WATCH

Photo by Gene Furr



*Much of the land in this 1976 photo of the Cape Hatteras lighthouse has been claimed by the sea*

The ocean  
Is coming,  
The ocean  
Is coming

That, we are told, is a fact. But the habit of holding one's own is a hard one to break. Walls, boulders, bulkheads and riprap—we have thrown everything we had at the sea, and still it keeps coming.

*Continued on next page*



The cry goes up—"Save the Hatteras Light!"—and thousands rally to help, while the lighthouse itself stands resolute, brave as a banner.

But while we battle the sea for inches on one hand, it steals yards on another. Houses topple, walls collapse. The sea keeps coming. State officials go about the often unpopular job of planning an orderly retreat. And the geologists are saying—to paraphrase Pogo—the enemy is us.

This month, *Coastwatch* looks at the problem of beach erosion, and what can be done about it.

Photo by Steve Wilson



## What's eating at North Carolina beaches?

The word itself is a part of the problem. Erosion. Inland, it means gullied banks, silted streams and airborne topsoil. Erosion, we've been taught, is something man provokes when he disturbs the earth, and something he can stop—with walls, plants or more prudent farming.

But the sea erodes an ocean beach whether man is there or not, and geologists say that, while we might temporarily divert beach erosion from one place to another, there is nothing we can do to stop it.

As long as sea level continues to rise, our barrier island beaches will recede, and the islands themselves will "migrate" landward.

"Things out here aren't like inland areas," says Spencer Rogers, Sea Grant's coastal engineering specialist. A few hundred feet outside his office at the N. C. Marine Resources Center at Ft. Fisher, the sea is marching steadily landward.

"Geology is an active, real process out here on the beach," Rogers continues. "You can leave your lot in Raleigh on the day you're born, come back to it in seventy years, and there will be practically no change in the shape of the lot. If you have a lot on the beach that long, it's going to change dramatically. It may disappear altogether."

Most of North Carolina's 320 miles

of island beaches are backing up. Some 48 percent of the shoreline has been eroding at a rate greater than two feet each year. Eighteen percent of the coastline has been disappearing at an annual rate of more than six feet a year.

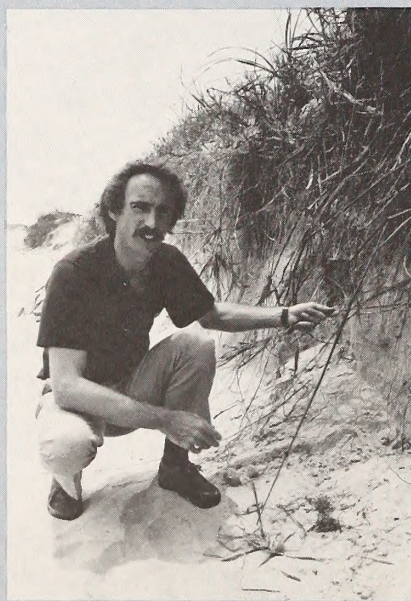
But about 54 miles of North Carolina beaches are actually gaining ground, "accreting." Some of this accretion happens when a beach collects sand lost from the opposite shore of a shifting inlet. Other beaches are accreting or eroding only very slowly because they face south, which gives them some shelter from the severe storms called northeasters, or because they are positioned in such a way that they catch sand lost from nearby capes.

This landward march is not as orderly and predictable as mere statistics make it seem. Areas such as North Rodanthe and Pea Island in Dare County, and Seagull in Currituck County, are eroding at mysteriously high rates. And, when it comes to a major storm or hurricane, no one can predict with confidence the reach of erosion.

"Geology responds to the high-energy storm events," says Stan Riggs, an East Carolina University geologist and Sea Grant researcher. "The energy expended day-to-day is not much compared to what is released in a catastrophic storm."

Riggs and Rogers explain that while the record may show a certain beach eroding two feet a year on average, a single storm might bring thirty years'

Photo by Neil Caudle



*"You can leave your lot in Raleigh on the day you're born, come back to it in seventy years, and there will be practically no change in the shape of the lot. If you have a lot on the beach that long, it's going to change dramatically. It may disappear altogether."*

*—Spencer Rogers*





*Sandbag groins are used to reclaim lost beachfront*

worth of erosion overnight. And, although much of the sand lost during storms returns, gradually, with calmer weather, that is no consolation to someone whose house collapsed after a storm tide swept the land right out from under it.

"One of the troubles with predicting erosion rates is that we really do have no idea how to predict what the short-term erosion is going to be like during a major storm," Riggs says. "In a major hurricane, the barrier island itself becomes the surf zone, with twenty-foot waves crashing against the buildings. You can't design anything to withstand that."

There are never very many people or machines around logging data and taking notes during a major hurricane. And, the exact interaction of waves, wind, sand and buildings is still unknown. Also, the mathematical models available for predicting short-term erosion do not take into account all of the variables.

John Fisher and Margery Overton, two North Carolina State University (NCSU) civil engineers, are doing Sea Grant research into one of those

variables—the role of dunes in short-term storm erosion. They say that predictive models have been based on the assumption that a storm would take as much sand from the dunes as it needed to offset the increased wave energy and reassert what has been called a "dynamic equilibrium."

"The old model depends on looking at the beach profile if an extreme storm took the beach to an equilibrium, on the assumption that beaches tend to erode to a stable profile, a geometric shape," Fisher says.

And Overton continues: "In the case that you have a shorter-term storm, a model like that is not going to be appropriate, because the beach won't have had time to reach that state."

Fisher and Overton are using a wave tank to simulate dune erosion and suggest ways to shape their model. They are trying to find how much sand is eroded from a dune with each "uprush" of water, so that, given the strength and number of uprushes, and the storm's duration, they may be able to predict the rate of dune loss.

"I think the motivation for this, in terms of the state's interest, is that the

FEMA guidelines (federal flood insurance) assume that if there are dunes present, then the waves will not breach them, and that therefore dunes are barriers to storm penetration," Fisher says. "But we all know that dunes are lost. Areas that look relatively safe on FEMA maps turn out to be not very safe."

Fisher and Overton say they plan to collaborate with scientists in Holland, where battling the sea is a way of life. Fisher says the Dutch are doing the most advanced work in beach processes.

"They're afraid that when that big storm comes along, most of the low-lying parts of Holland will go with it," Fisher says. "They want to be sure that they know just how stable their dunes are."

While scientists and public officials grapple with the immediate problem of how to improve the guidelines for coastal construction, most of them agree with the geologists that no computer model, building code or setback rule can guarantee a beach house safety. The forces behind beach ero-

*Continued on next page*



sion, they say, are simply greater than our means for understanding them.

Last fall the U. S. Environmental Protection Agency released the results of a study concerning the so-called greenhouse effect, created by the buildup of carbon dioxide in the upper atmosphere, and its presumed influence on sea levels. The most publicized portions of the agency's report were the worst case projections, one of which suggested that sea level could rise off the Carolinas as much as two feet by the year 2040. Such a rate would be four times or more the present rise, which has been estimated at one-third foot to one foot per century.

While such a drastic sea level rise might indeed doom the barrier islands of North Carolina, Riggs says the projections are too "iffy" to be useful now. Sea levels rise because of melting ice caps and glaciers, but also, some scientists believe, because of compaction in undersea sediments or a gradual sinking of the continental land masses.

And, while the world's ice has been melting for thousands of years, it seems to have been melting less rapidly recently. Riggs says it is possible that the world is about to experience a shift toward more glaciation and slowly lowering seas.

"The last four or five times that sea level changed, it changed about now in the cycle, toward more glaciation," Riggs says.

But "about now" in the context of world geology could mean hundreds or thousands of years. And Riggs says he makes the point not to raise any hope that the sea may stop attacking and retreat soon, but only to illustrate that the greenhouse effect is only one of a number of forces shaping the seas and coasts.

Another obstacle to understanding beach erosion is that the part of the beach we see is actually only a fraction of what is eroding. And what happens unseen under the wave may have more impact on the beaches than we have thought.

John Kraft, a geologist at the University of Delaware, has been doing Sea Grant research in Delaware's nearshore waters, and has found the beachface there eroding all the way out to 325 yards offshore, in 30 feet of water.

Kraft says that he and others had assumed that sand placed on the beaches during so-called beach nourishment projects helped restore a

gentle slope to the underwater beachface by making more sand available to the system. It was partly because of this assumption that beach nourishment has been regarded as the method of choice for beach protection (see page 5).

But when he took core samples of the sediments under water, Kraft found the sand layer surprisingly thin. Where he had expected to find several meters of sand, he found only one and one-half meters at the thickest. In some areas, old sediments had been laid bare and were eroding.

Kraft believes the slope of Delaware's beaches is getting steeper because beach managers have decided to hold a line and protect beachfront development. The rising sea, unable to advance at the top of the beach slope, advances instead nearer the foot, and the slope steepens.

Kraft says that for every meter of elevation lost on the beach berm, ten more are being lost along the length of the beachface under water. He explains that most of the sand added during beach nourishment soon disappears into "sediment sinks" far offshore, or in bays and estuaries.

"Suppose you're a beach manager, and I told you that if you replenished the beaches with three hundred and fifty thousand cubic yards of sand each year, you could keep the beaches stable forever," Kraft says. "You'd

probably spend the five dollars per cubic yard to do this—at an annual cost of more than one-point-seven-million dollars.

"But suppose I told you that ten times this amount of sediment is moving along the beaches into Delaware Bay and out on the inner shelf. You'd have to spend ten times as much—seventeen million dollars per year—to keep the beaches stable. You may want to change your mind."

Kraft says that one danger in holding a line against beach erosion is that the steeper slope of the beachface will increase the risk of property damage during storms. And, because the dry part of the beach seems, to the casual observer, to be stable, some property owners may underestimate their lots' vulnerability.

"The more you steepen the slope, the closer the average large wave comes to the beach itself, and the more damage it can do," Kraft says.

Kraft says he would expect to find the same erosion pattern on nourished shorelines in North Carolina. "I think it's happening all over," he says.

So what can be done about beach erosion? The obvious answer, to some, is, don't fight it, retreat: Build moveable houses; build far back from the sea, or don't build on barrier-island beaches at all. Perhaps the most-quoted proponent of this view is Orin Pilkey, a Duke University geologist.

*Photo by Jerry Machemehl*



*This beachfront home was undermined by a 1973 northeaster'*

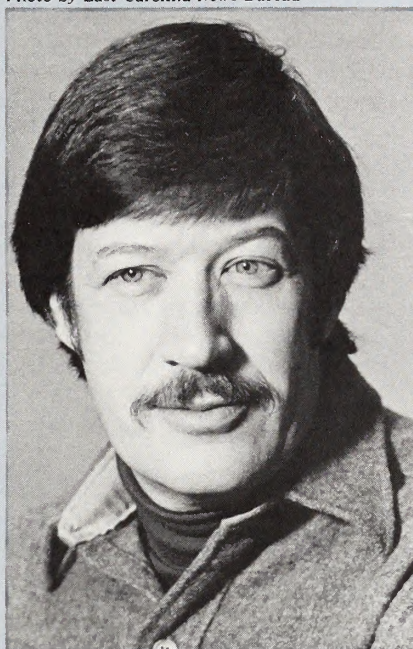


Pilkey proposed five "solutions" to beach erosion in *From Currituck to Calabash*, a book he wrote with his father and William Neal:

1. *Design to live with the flexible island environment. Don't fight nature with a "line of defense."*
2. *Consider all man-made structures near the shoreline temporary.*
3. *Accept as a last resort any engineering scheme for beach preservation, and then, only for metropolitan areas.*
4. *Base decisions affecting island development on the welfare of the public rather than the minority of shorefront property owners.*
5. *Let the lighthouse, beach cottage, motel, or hot dog stand fall when its time comes.*

—Neil Caudle

Photo by East Carolina News Bureau



*"One of the troubles with predicting erosion rates is that we really do have no idea how to predict what the short-term erosion is going to be like during a major storm."*

—Stan Riggs

## Holding the line against erosion

It's called hardening the shoreline: setting up a barrier between the sea and the land. In North Carolina, most of the methods for holding the line against erosion require official permits; others are forbidden. None of these methods has escaped criticism, although one—beach nourishment—is favored for its flexibility.

Here are some of the common ways of fending off the sea:

### Beach Nourishment

"Beach nourishment is the method of choice because it has fewer adverse effects, and it provides a recreational beach," says Spencer Rogers. "But it is expensive and it must be maintained. It's not a cure for an erosion problem, it's just a treatment for one."

Rogers says the success of such projects depends on reliable funding, favorable wave and weather conditions, a ready source of suitable sand, and good engineering.

Federal funds, which have in part supported beach-nourishment projects are becoming scarce, Rogers says. Some towns have established a resort

tax on rented rooms, with the revenues dedicated to beach-nourishment projects.

But Rogers says that some small beach communities may not have an economic base broad enough to adequately maintain increasingly expensive beach-nourishment projects.

Rogers also says that some communities, such as those on the Outer Banks, where powerful waves and currents keep great quantities of sand "in transport," will find their expensive sand disappearing at a greater rate than at more protected sites.

And, while some towns can replenish their beaches with sand pumped from shoaling inlets nearby, others cannot always find good sand.

Steve Benton, a geologist with the Office of Coastal Management, says that the biggest problem with beach nourishment is "where you get the material and when you put it on the beach."

### Seawalls and Bulkheads

Expensive, massive and forbidden along much of North Carolina's coast,

seawalls are the hardest of devices for hardening a shoreline. Well engineered seawalls are often made of steel-reinforced concrete, and are very durable until they are undermined or flanked. They are frequently the choice when the goal is to protect a flood-prone coastal city. Seawalls cost about \$1000 a linear foot.

Bulkheads—retaining walls often made of treated wood—are less expensive (about \$200 a foot), less durable, and share the problem of seawalls: the beach seaward of the wall almost inevitably disappears. Wave energy that would normally be absorbed on the ramp-like slope of the natural beach is instead deflected, eroding sand from the base of the wall and also from adjacent property.

North Carolina regulations do not permit either structure to protect beachfront buildings begun after June 1, 1979, largely because the regulations' goal is to preserve not only property, but the beaches.

Rogers says there is also an economic reason for allowing the

*Continued on next page*



shoreline to flex enough to maintain a natural beach.

"If the beach is not there you can't begin to fill the motel rooms," he says.

## Groins

Groins on the beach are usually low walls placed perpendicular to the shoreline in order to trap sand moving in longshore currents. Groins are made with a variety of materials, including sandbags, riprap, and closely spaced posts of wood or concrete, at a range of costs.

Groins rebuild the beach immediately "upstream" of the wall, but they do so at the expense of the beach downstream, because they intercept some of the sand supply. A series of groins tends to give the shoreline a severely scalloped or serrated shape. To work, groins must cross the public beach and extend well into the surf. There have been reports of strong rip currents forming along the downstream sides of groins.

Rogers says that although property owners can usually get a permit to build groins, they are not widely used on North Carolina beaches, mainly because they frequently fail during storms. But he says that well designed groins can help moderate fluctuations in the banks of an inlet.

"The reason groins can be considered for an inlet is that sand is being pushed up into shoals inside, which usually does nobody any good," Rogers explains. "The idea is to catch it before you lose it."

## Fabrics and Artificial Grasses

Two man-made materials have raised some hopes in North Carolina recently because of reports of their success in building beaches or

preventing erosion. One of these is a fabric that a major oil company has claimed protects shorelines from erosion. The other is an artificial sea grass designed to be installed in the surf zone, where it may or may not help trap and collect sand.

Rogers says that the fabric is best used behind walls or bulkheads, where it can help retain sand while allowing water to move. But, while it may improve the durability of a rubble retaining wall, the fabric itself does not control beach erosion, Rogers says.

"A lot of people seem to have the understanding that you can lay this fabric on the ground and it stops erosion," Rogers says. "It's a good filter fabric, but the success or failure of this kind of system depends not on the fabric but on the very large rocks that you pile on top of it."

As for the artificial sea grass, which homeowners have begun to buy and install in some areas, Rogers suggests caution: "It's by no means a new method. It's been around several decades, and has in general proven to be ineffective in an ocean-wave environment."

Much of the optimism about the artificial seaweed arose from reports that the beach around the Cape Hatteras lighthouse was rebuilding after the material was installed in the surf there.

In September 1983, a team of scientists and engineers gathered to study erosion patterns around the lighthouse. (The team included Rogers, Steve Benton, John Fisher and Margery Overton of NCSU, Robert Dolan and Lorraine Lisle of the University of Virginia, Curt Mason of the U. S. Army's Coastal Engineering Research Center at Duck, and Kent Turner of the National Park Service.)

The team reported that, while the Cape Hatteras shoreline shows "a dominant pattern of long-term ero-

sion," there have been occasional periods of accretion. The study found that beach nourishment, a newly constructed groin, and changes in wave and sediment-transport patterns have probably had the most influence on accretion at the lighthouse.

"While there has been some buildup in that area, it's also built up nearby, where the artificial vegetation could not have had any effect on the beach," Rogers says. "The accretion seems to be part of natural fluctuations in the shoreline."

## Precautions

Although Rogers advised people to be careful of how they spend their money on devices to control beach erosion, he does offer some suggestions about how to protect their property and safety:

—Before you build on the beach, find out the estimated erosion rates for the lot and build on the site that affords the greatest protection. Your local CAMA permit officer can advise you.

—Build on pilings sunk deeply enough to support the house in case short-term erosion removes the dunes and some of the beach profile.

—Plan the building so that it can be moved when erosion threatens it. Many beach houses constructed on piles can be moved for a fraction of their construction costs.

—Practice dune conservation. (Sea Grant researchers Ernest Seneca and Steve Broome of NCSU have developed techniques for planting beach grasses and protecting dunes. For a free copy of their book, "Building & Stabilizing Coastal Dunes with Vegetation," write UNC Sea Grant Publications, 105 1911 Building, NCSU, Box 8605, Raleigh, NC 27695-8605. Ask for UNC-SG-82-05.

—Neil Caudle

Photo by Jim Page



A seawall is used to harden the shoreline at Atlantic Beach



Photo by Jim Page



Photo by Les Thornburg



## Barriers to the sea

*Beach nourishment is a favorable, but expensive, way to hold the sea at bay (above). Groins and jetties, placed perpendicular to the shoreline, trap sand moving in currents along the shore (left). Bulkheads like this are no longer permitted to protect beachfront structures built after June 1, 1979 (below).*

Photo by Steve Murray





# Oceanfront development has its setbacks

In New Jersey, the damage is done. Waves crash at the bases of seawalls first built long ago to protect beach cottages and resorts. The sea, its energy deflected, scours sand from the walls' foundations. The rubble of failed walls lies scattered in the surf. The walls grow taller and mightier with each rebuilding. The cottages and resorts survive, but there is no beach. There is also no turning back.

But the specter of what has been called "New Jerseyization" has neither stopped nor slowed the pressure to develop North Carolina's beaches. And for better or worse, the fate of those beaches rests largely on a much-assailed and debated regulatory device called a setback.

North Carolina adopted its first ocean setback regulation in 1979, under its Coastal Area Management Act (CAMA). The Coastal Resources Commission, a board appointed to direct the state's coastal management program, adopted a rule that new beachfront development in "ocean hazard areas of environmental concern" (which include the ocean beaches) must be situated in such a way to meet several requirements. The most restrictive of these was the requirement that new buildings must be placed 60 feet landward of the vegetation line, or at a distance thirty times the long-term annual erosion rate, whichever is greater. This rule came to be known as the setback.

The setback did not please everybody. Beach developers have accused it of setting back not only the buildings, but builders and local economies as well. Some have challenged the validity of methods used to determine long-term erosion rates, on which the setback is based. And even the setback's defenders have called it a compromise that reflects the realities of state politics as much as it does the realities of beach erosion.

The controversy over oceanfront setback made headlines again last fall, when the Coastal Resources Commission

doubled the amount of beach setback for new buildings of four or more dwelling units, or of more than 5,000 square feet. After hearing from irate developers, the commission put a cap on the increase. No setback would increase by more than 105 feet.

In its public statement, the commission gave this explanation for the need for increased setbacks: "Large structures are more difficult, legally or practically, to relocate when threatened by storms or erosion." And, the statement continued, when buildings are placed too near the ocean, "there is an increased risk of loss of public beach, and an increased cost to the public due to more expensive disaster relief, flood insurance, erosion control, and the repair and replacement of public services such as water and sewer."

Dave Owens, assistant director of the state's Office of Coastal Management, says the commission weighed all the concerns and "came up with a number they felt was reasonable and practical, given the realities they were facing."

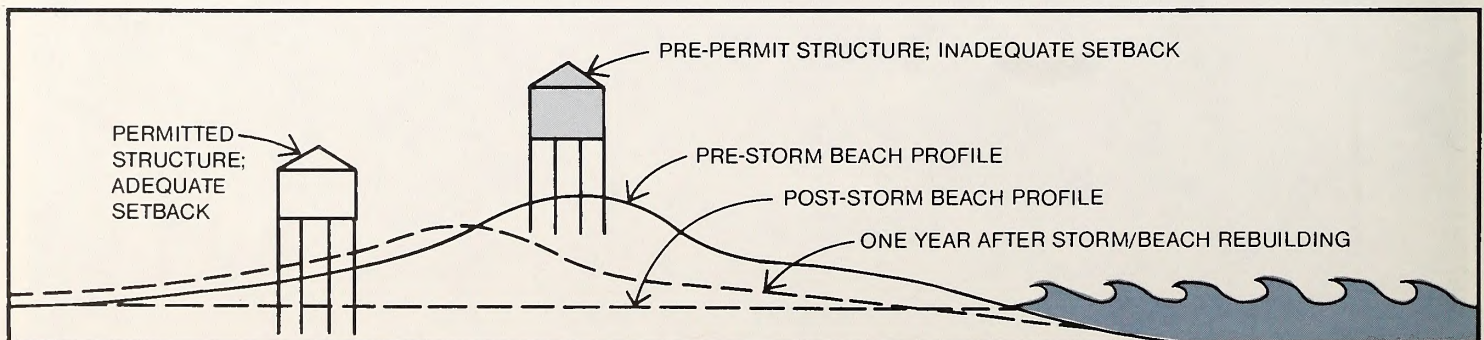
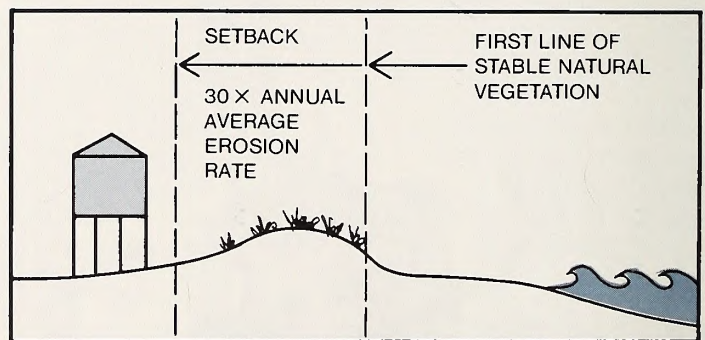
Even so, the new setback rules drew fire. Dare County's Board of Commissioners denounced the setback and, by way of protest, voted to withdraw the county from participation in the coastal management program. (The withdrawal did not make Dare County exempt from CAMA regulations. Officials say the only change will be that the minor permits program will be administered by staff from the Office of Coastal Management's field office in Elizabeth City, and not by Dare County.)

Opponents of the setback said it would stunt economic growth.

David Watson, president of the Dare County Board of Realtors, says that many hotels are built near the ocean because their patrons like it that way.

"If you set the building back several hundred feet, it may

*Setback regulations require buildings along the oceanfront to be placed behind the frontal dune; landward of the crest of the primary dune; and, set back from the first line of stable vegetation at distance equal to thirty times the annual erosion rate or 60 feet, whichever is greater (right). After the storm, the house on the dune will be gone. The other has a much greater change of survival (below).*







*No dunes offer protection for these oceanfront homes*

mean that the hotel is going to last longer," Watson says. "But it doesn't mean it's going to be better."

Watson says he believes the new setback will mean that fewer hotels will be built, that some beachfront property will be devalued, and that, as a consequence, Dare County will find its tax base too restricted to handle its tourist trade. He says that there are already too few rooms to rent in Dare County.

"It's my feeling right now that when you're running at one-hundred-percent occupancy, you need some more rooms. And with these new regulations, we're not going to get them. Our community is changing, and we are attracting more affluent visitors. People with more means demand services—nice hotels, nice facilities.

"With the limited amount of land left, I think you're going to see more big projects, fewer smaller ones," Watson says.

But the opposition from leaders in coastal communities is not unanimous even in Dare County. Don Bryan, who last fall was re-elected mayor of Nags Head, is a member of the commission and an advocate of the setback regulations.

"My view is that the Coastal Area Management Act has furnished a tool with which we can make people aware of the problem. It helps us form rules that will benefit oceanfront property owners from the standpoint of protecting the public from loss in the long run, and from the standpoint of protecting the public's interest in the beach."

Bryan says he thinks the results of the mayoral election "indicate that the citizens of Nags Head are satisfied with my stand."

Before last fall, some 500 beachfront lots were undevelopable in North Carolina at least partly because of the

setback regulations. Many of these lots simply did not have the buildable depth to accommodate the setback. Officials say the new regulations will make a smaller number of lots eligible for condominiums and other large structures, the more profitable variety of development in many areas.

But Owens says that many of these lots affected by setbacks could not be used anyway, often because of problems with sewage treatment or drainage.

"When you look at many of the developed beach communities and you see a stretch of undeveloped property, there's frequently a very good reason for that," Owens says. "The marketplace has recognized that these lots are unsuitable for development."

"Development pressure is continuing, but the supply of good land is constricted, so, over time, there's more and more pressure on these marginal lands," Owens says.

Owens points out that many developers have actually supported the setbacks. He says that, within the increased setback zone, "You can still place traditional beach cottages, duplexes, quadraplexes, swimming pools, and parking lots. You can design around it."

"I think it (the opposition to setbacks) primarily goes back to a philosophical objection people have with government telling them what they can and can't do with their property—setting some constraints," Owens says. "Because the economic impacts of this increase I don't think are all that significant."

By what authority does the state restrict the use of private property? Walter Clark, Sea Grant's coastal law specialist, says the state's authority lies partly in what has been termed its "police power," the power, he says, "to

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protect lives and property and the general welfare."

Clark says that while the courts and the public are familiar with the legal aspects of owning private property, the public's rights to beaches are not as generally understood.

"Right now, the part of the beach now in public trust is only considered to be between mean-low and mean-high tide," Clark says. "But it might be shown that the public has acquired an implied easement to the berm as well."

Clark says that the public right to public land is at issue when a beach disappears in front of a seawall, or when a building encroaches on the recreational beach. The Coastal Resources Commission, he says, has decided that setbacks are the most practical way to protect all the vital interests—public and private.

Clark says that even though North Carolina's setback regulations have stood up well in court so far, there will be other challenges ahead, especially to the regulations concerning seawalls and bulkheads.

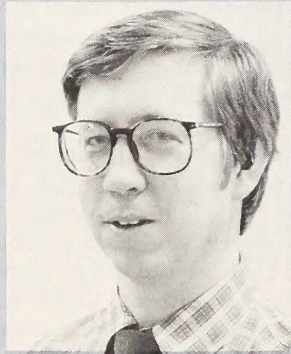
He gives as an example the case of a beachfront cottage with waves lapping at its foundations. If that cottage was built before the setback rules took effect in June 1979, the owner can often get permission to build walls between his house and the sea. But if the construction began after that time, regulations say no walls, period. Unless it is moved, that post-1979 cottage may soon be a pile of kindling on the beach. And the owner will have to clean it up.

Clark points out that few of the biggest, newest or most expensive development projects have been threatened yet, since most have built in accordance with the setbacks.

So what happens twenty or thirty years from now, when the sea is at the doorsteps of big hotels and condominiums?

"It's a very difficult proposition," says Dave Owens. "You've got somebody sitting there with a couple-million-dollar investment, and the local government's looking at the tax revenues it's bringing in, and it's impractical to move it. Then, the commission is faced with, well, what do you want

Photo by Steve Wilson



*"Development pressure is continuing, but the supply of good land is restricted, so there's more and more pressure on these marginal lands."*

*—Dave Owens*

us to do, let it fall in the ocean? And that's a very difficult thing to put to a commission. So far, they have not granted any variances to let people put in hardening devices, but they are looking into allowing some temporary things, like sandbags."

Owens pointed out that, while the setback is based on erosion data gathered from 30 to 40 years worth of aerial photographs, the setback calculations can not predict the future or guarantee anyone safety. He says his office is

Photo by Steve Wilson



*Oceanfront building is a calculated risk*

always looking for ways to improve the methods by which erosion rates are determined.

Some opponents of the state's approach to managing the shoreline have expressed a preference for methods used to control beach development in Florida. There, all new buildings permitted seaward of a "coastal control line"—a line frequently several hundred feet landward of the beach—must meet very stringent construction standards for durability and storm-resistance.

But Spencer Rogers, Sea Grant's coastal engineering specialist, says that the Florida method, while not relying on setbacks, might even be more restrictive to new construction than some people think."

"If Florida's program were applied here, a lot of the buildings that are going in here wouldn't be," Rogers says.

"North Carolina's program is certainly one of the most effective at addressing the hazards of coastal development," he adds. "But even so, it's a compromise; it has to be to exist, and it has limits. It's by no means a cure to development, erosion and storm damage."

Rogers says that too many people build immediately behind the setback line, even when they have room to spare. Rogers helped Alan Stutts and Crystos Siderelis of NCSU complete a study of setbacks and construction in several of the state's beach communities. In these towns, the study found that most new buildings were placed within 10 feet of the setback line.

Many of these structures were sited at the line for practical reason—the lots simply were not deep enough to accommodate more setback. But other buildings representing about 30 percent of the group surveyed, were sited at the setback line even though there was room to spare. In these cases, builders may have sacrificed years of erosion protection for a closer view of the sea.

Rogers adds that the problem is compounded by the fact that the eventual homeowner is frequently not the homebuilder. Developers apply for permits, and receive Coastal Management's warnings about the property's vulnerability to erosion and storms. But very often, these warnings never reach the homeowner.

There have been several drafts of a bill that would require disclosure of such hazards to prospective buyers of coastal property. But these have all failed to gain support among legislators.

So, for now, it is "buyer beware." And, as Rogers points out, too many buyers simply aren't aware.

*—Neil Caudle*



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



Bringing up the anchor of the Monitor, seashell collecting from a diver's perspective, federal and state laws on wreck diving and salvaging, diving in the Caribbean and Hawaii. You'll find out about all that and more at SEAS '84. It's the Southeast Atlantic States Diving Conference and Underwater Film Festival.

The three-day conference will be held February 24 through 26 at the Radisson Hotel in Raleigh. Jim Murray, director of Sea Grant's Marine Advisory Service, says the conference is a weekend of workshops, exhibits and films. You'll meet a panel of local and national diving experts who will tell you about everything from the shipwrecks off the North Carolina coast to underwater photography. You'll be able to take a look at all the latest in diving gear, and if you're a photographer, you can enter a photography contest.

Murray says the conference is geared toward the sports diver and those interested in the marine sciences.

The event is sponsored by UNC Sea Grant, the N.C. Marine Education and Resources Foundation, the N.C. Office of Marine Affairs, and the N.C. Wreck Divers Association.

If you register before February 10, the cost is \$15 for the workshop, \$5 for the social, \$6 for the film festival, and \$10 for the banquet, or \$36 for the entire weekend.

For more information about registration or about the photography

contest, contact Jim Murray at (919) 737-2454 or Doug Young at (919) 733-2290.

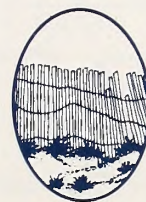


The National Estuarine Research Symposium will be held March 13 through 15 at the Marriott Hotel in Raleigh. The symposium, sponsored by Sea Grant and National Marine Fisheries Service, will explore the future research needs of our nation's estuaries.

During the symposium, prominent scientists from across the nation will tackle five subject areas: the impact of water management on estuarine productivity, the impact of sediment management on estuarine productivity, the impact of nutrients and chemicals on estuaries, the coupling of primary and secondary productivity in estuaries, and fisheries habitats.

From the papers presented and discussions held, a committee headed by UNC Sea Grant Director B.J. Copeland will develop a national strategy for estuarine research that will provide a sound scientific base for future management.

To register for the three-day symposium, send \$40 to UNC Sea Grant, 105 1911 Building, North Carolina State University, Box 8605, Raleigh, N.C. 27695-8605. Make checks payable to: UNC Sea Grant. The registration deadline is March 1.



Spencer Rogers, Sea Grant's coastal engineering specialist at Ft. Fisher, is looking for someone with property on an estuarine shoreline who can help him test a new erosion-control method.

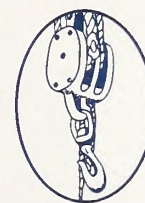
Rogers says that the device, which is designed for use on the shores of sounds or bays, combines a small wooden breakwater with protective

plantings of marsh grasses. Rogers wants to find one property owner who will be willing to pay construction costs and cooperate with the research. Rogers says the cost of the system will be half to two-thirds the cost of a bulkhead.

"Like most low-cost means of erosion control, there are no guarantees," Rogers says. "But this system may be effective in areas with up to a three-foot wave, and a bottom that drops one to two feet in the first one-hundred."

If you would like to talk with Rogers about the experiment, contact him at the Marine Resources Center at Ft. Fisher, General Delivery, Kure Beach, N. C. 28449 or call (919) 458-5498.

UNC Sea Grant has received approval for its 1984 renewal budget request. The program will be awarded \$1,175,000 in federal funds to complete the second year of its biennial program proposal.



If you would like to know more about the potential for a squid fishery, then Sea Grant has a workshop for you. Sea Grant's Southeast Marine Advisory Services, the National Marine Fisheries Service and the Gulf and South Atlantic Fisheries Development Foundation are sponsoring a squid workshop, January 26, from 6 to 10 p.m. at the Marine Resources Center in Manteo.

The workshop will begin with a social where participants can get a taste of squid and peruse squid products. At 7 p.m., a panel of experts will be assembled to discuss the potential of the fishery, location of the squid resource, quantities of squid available, harvesting methods, onboard handling procedures, processing and marketing. A question-and-answer session will follow.

The workshop is free. For more information, contact either: Jim

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Murray, 105 1911 Building, North Carolina State University, Box 8605, Raleigh, N.C. 27695-8605 (919-737-2454) or Wayne Wescott, Marine Resources Center, Box 699, Manteo, N.C. 27954 (919-473-3937).

Neil Caudle, UNC Sea Grant's Director of Communications, will resign his position effective March 31. Caudle, who has been with the program for over four years, is leaving to pursue a career in freelance writing.



UNC Sea Grant, the N.C. Office of Marine Affairs and the N.C. Agricultural Extension Service are sponsoring an estate-planning workshop for commercial-fishing families at the Marine Resources Center on Roanoke Island on February 9 at 7 p.m. Lawyers will be on hand to help families understand the implications of estate planning, explaining how they can save money and insure the security of their families.

The workshop will cover property ownership, wills and the effects of taxation. For more information about the workshop, contact Rhett White at the Marine Resources Center on Roanoke Island at (919) 473-3937.



The National Marine Education Association (NMEA) is offering 20 National Youth World of Water Awards to seventh- to twelfth-grade students who have won a local, state, regional, national, international or special-event science fair with a marine or aquatic research project during 1983-84. NMEA will also present five awards to undergraduate students who have completed an aquatic or marine research project during 1983-1984.

Winners will receive a plaque and an expense-paid trip to Washington, D.C., to attend Oceans '84, a prestigious oceanographic and ocean-industry convention. For more information about the awards, contact Lundie Spence at UNC Sea Grant, 105 1911 Building, North Carolina State University, Box 8605, Raleigh, N.C. 27695-8605 or call (919) 737-2454.

The UNC Sea Grant Program has a new address. We have not changed locations, but because of changes in mailing procedures at North Carolina State University our address and zip code have changed. Our new mailing address is: UNC Sea Grant College Program, 105 1911 Building, North Carolina State University, Box 8605, Raleigh, N.C. 27695-8605.

Last month we reported that Jim Bahen was experimenting with a shrimp trap. Bahen received many calls from folks wanting to purchase a trap. But hold the calls because Bahen is advising people to delay their purchases until more information about the traps is available. Regulations governing the use of the traps are unclear and the Division of Marine Fisheries (DMF) will be working with Bahen to study the traps. Later DMF will be developing a new set of regulations. Watch the Back Page for more information about the shrimp traps.

Larry Giardina, Sea Grant's marine advisory agent at Bogue Banks, left the Sea Grant Program in November to return to the west coast. Giardina, who specialized in business and marketing, had been with the program for two years.

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## COASTWATCH

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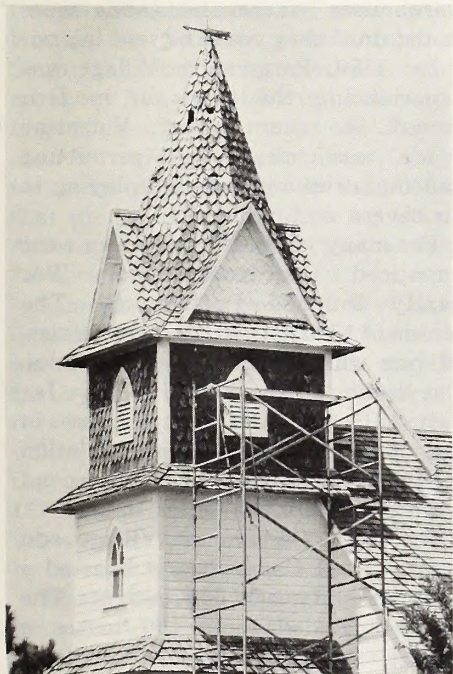


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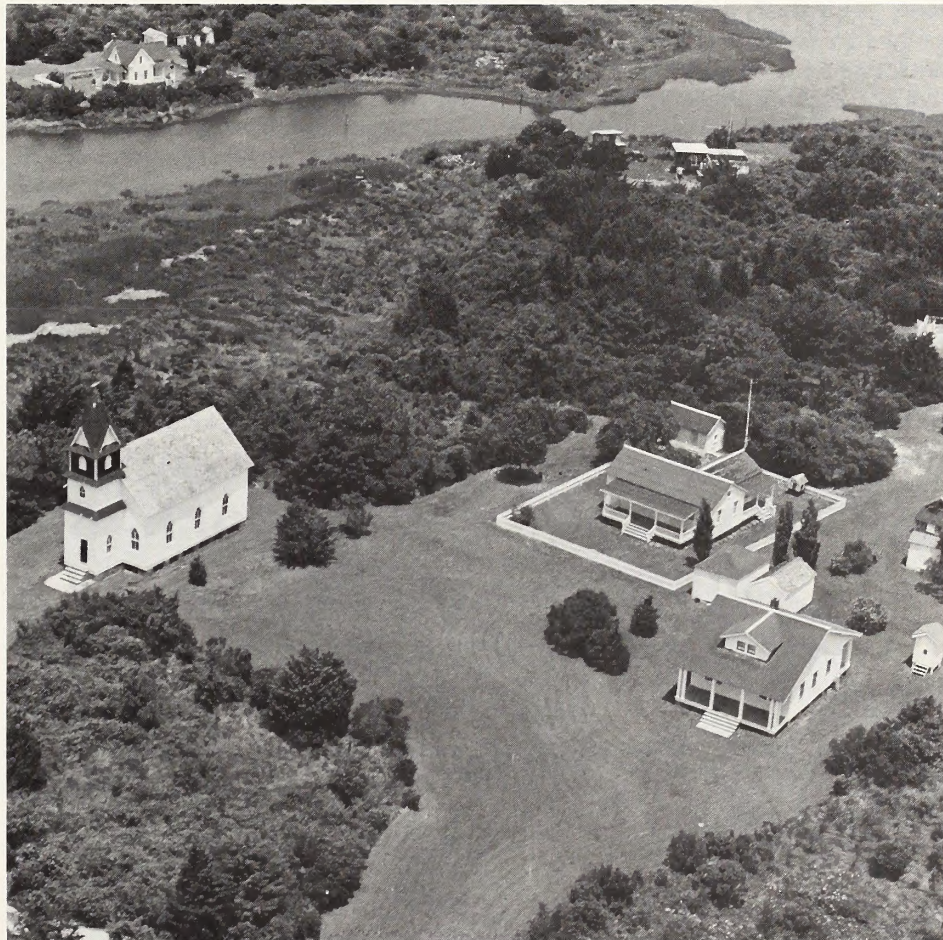
MAR 7 1984

# COASTWATCH

Photo by Gene Furr



N.C. Travel and Tourism photo



## Towns that were

*Portsmouth church steeple (left); Portsmouth from above (right)*

Towns with names like Exeter, Old Town Point, Brunswick Town, Charles Town and Buffalo City once dotted the maps of coastal North Carolina. Towns whose only link to the present is a crumbling wall, an abandoned house, an excavation, a recollection.

The Roanoke Island colony may be North Carolina's most famous abandoned settlement. But other towns have flourished and then died. Brunswick Town, established on the shores of the Cape Fear River in 1728, was envisioned as a seat of government

and a trading center. But a nearby town, first called Newton, then Wilmington, grew to overshadow Brunswick Town.

Hurricanes, politics and a lack of commerce caused the demise of several coastal towns and villages. State and county histories tell us about their fate. But two Carteret County communities, deserted during the twentieth century, are still fresh in the minds of a few former inhabitants. This month, *Coastwatch* takes a look at Portsmouth Village and Diamond City.



# Chronicle of a seaport village

Portsmouth Village is quiet now. But its history tells the story of a once-bustling community. Of a town that was established as a transshipment point, flourished for a while, then finally failed. Of a town whose residents managed to keep their village alive for another century. Of a town which, even today, folks still refuse to call deserted.

Portsmouth Island is the northernmost strip of land in Core Banks. The village lies on the tip of that island just across the inlet from Ocracoke.

Today, Portsmouth Village is part of the National Register of Historic Places. The Register recognizes outstanding historic buildings and districts. The 250-acre Portsmouth

historic district has been part of the National Park Service's Cape Lookout National Seashore since 1976 when the state turned deeds to the property over to the federal government.

Like so many coastal towns, Portsmouth's existence depended on an inlet. In the days when Ocracoke Inlet was kind to seafarers, Portsmouth prospered. Old records indicate that the North Carolina colonial legislature authorized the village in 1753 as a point where ships' cargoes could be lightered ashore for shipment to the mainland.

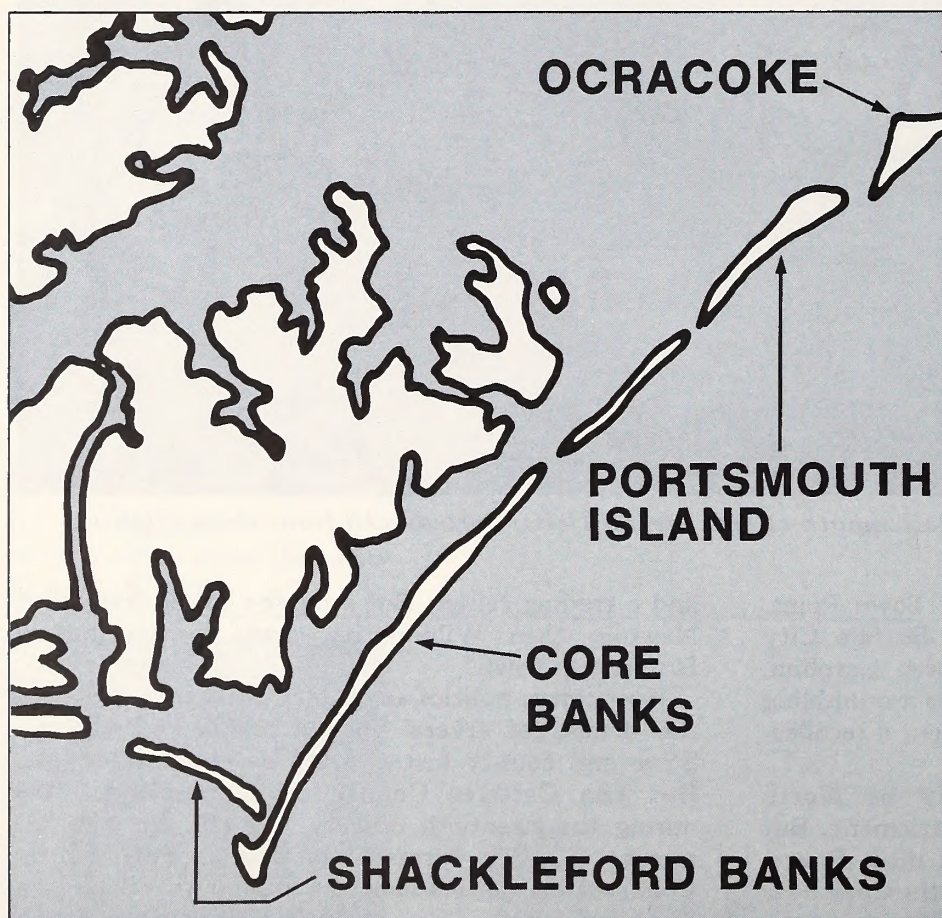
Portsmouth owed much of its commercial success to a tiny neighboring island composed entirely of oyster shells. Shell Castle Island, to the west

of Portsmouth in Ocracoke Inlet, served as a lightering station. Ships arriving at Ocracoke Inlet had their cargoes lightered to the island's warehouses where the goods were stored until they could be sent inland.

By 1759, Portsmouth Village was experiencing the perils of modern growth. A tavern owner, Valentine Wade, was charged with permitting dancing, drinking and card playing in his tavern on Sundays.

For many years, the tiny town went unnoticed. The Revolutionary War barely touched Portsmouth. The census of 1790 lists 96 free white males, 92 free white females and 38 slaves. The leading citizen, David Wallace Jr., owned 16 slaves and had two houses in the village. By 1810, with a population of 246, Portsmouth was the second largest town on the Outer Banks.

By 1860, Portsmouth Village and nearby Shell Castle Island boasted a population of nearly 600 residents. The village included about 100 houses, a church, several taverns, warehouses,



*A map pinpointing the location of Portsmouth and Shackleford Banks*



*Village post office*



shipbuilding yards and a post office.

But then came the Civil War. This war, Portsmouth didn't fare as well. During the first year, Confederate troops were stationed at Portsmouth. But as the Yankees pressed further South, the rebel soldiers withdrew and most of the inhabitants followed. Legend has it that only one Portsmouth resident stuck it out—by necessity. Supposedly, she was so fat that she couldn't fit through her door. According to the legend, the Yankee soldiers were kind to her.

Some say it was the Civil War that doomed Portsmouth. Others blame a major hurricane in 1933. Or, maybe there just weren't any jobs. Whatever the reason, only a fraction of the villagers returned after the war and the population steadily declined. By 1870 the population was 323. Just ten years later, that number had dropped by another hundred.

Those residents who remained continued to depend on the sea for their livelihood. But storms destroyed houses and more residents moved to

the mainland. A lifesaving station provided jobs for some residents from 1897 until 1938 when it was closed. In 1943, the doors to the one-room schoolhouse closed for good. The post office, opened in 1840, finally closed in 1959 when permanent residents numbered less than 15.

With the death of Henry Pigott, the island's last male resident, in 1971, the last two women left for the mainland (see page 4).

Portsmouth stands now—the town with no people. But, the village hasn't been ignored. Since 1978, the National Park Service has worked to stabilize the condition of the buildings. Some of the houses received a fresh coat of paint and new cedar shake roofs.

Bob Patton, the interpretive specialist with the National Park Service, says that while Portsmouth Village dates back to 1753, there is very little evidence of the early years. The oldest house still standing is the Washington Roberts house, built around 1850.

While the village is open to visitors,

the Park Service reminds that it's not easy to get there. You can reach the island by way of two concessioners who operate ferries from Ocracoke and from Cedar Island. Or, you can take your own boat to the island.

Patton adds that the management plan for the island doesn't call for making it any easier to get there. He says the Park Service is protecting the island by having limited access.

If you do plan a trip to Portsmouth, be prepared, says Portsmouth district ranger Dick Williams. Hardy mosquitoes, 99 percent humidity and no water—just a few of the things you'll be up against. Williams advises visitors to take insect spray, wear long pants and a long-sleeve shirt, and take along a supply of water.

Patton adds that for all the discomforts, it's well worth the trip. "It looks and feels just as it once did. And the challenge of getting to Portsmouth makes the visitor more appreciative of what it must have been like years ago," says Patton.

—Nancy Davis

## Class of 1916

*Children with familiar Portsmouth names like Salter, Babb, Gilgo and Dixon pose for their class portrait. After the turn of the century, the number of school-aged children on the island steadily declined. A new school was built in the 1920s, but its doors closed for the last time in 1943.*



National Park Service photo



# Portsmouth: a town without people

National Park Service Photo



*Henry Pigott at about 14*

*Photo by Steve Murray*

Portsmouth Village may have seen its better days, but it's far from dead.

Ask its residents—well, former residents. They've left their village, but they haven't deserted it, they say.

Consider Marion Babb. She was one of the last children born on Portsmouth Island. That was in 1922 when there was still some life left in the already declining village. But, even then, Portsmouth was breathing its last breaths.

In 1971, Babb and her aunt moved to the mainland, the last permanent residents to leave the seaport village. But their home stands today, freshly painted, yard mowed, ready for their return. Babb points to a color photo of the old homeplace and says, "That's home. And it'll never be anything but home."

Although the National Park Service controls the land and buildings on Portsmouth Island, Babb maintains a lease on her house. For her and others like her, it's more than sentiment that draws her back. "I wish I could go back and stay forever—the quiet, no telephones," she says.

Babb remembers the good life. It was a time when all the young folks on the island would have candy parties or ice cream parties. Or, they'd play a little canasta, dominoes or chinese checkers.

She remembers having all the necessities plus a little more. A wooden tank held 1,600 gallons of water, a generator provided light and, in later years, they had a gas stove. Most of the homes had outdoor toilets as well as outdoor cooking houses, called summer kitchens, for cooking in hot weather. And, even



*Former Portsmouth residents claim the fertile island marshes produce the best oysters in the world*



*"Portsmouth is more of a state of mind. It's the love the poeple have for the village that really keeps it going."*

*—Margaret Willis*

though she's living on the mainland now with the luxury of electricity, Babb still refuses to give up her kerosene lamps.

Once a month, a minister came from Ocracoke to preach in the little church next to Babb's house. Even the mail came to the island until the post office closed in the 1950s. Then, it was up to the island's last male resident, Henry Pigott, to row out into the channel to pick up the mail.

The Portsmouth residents were a mail order society, says Bob Patton, interpretive specialist with the National Park Service. The islanders placed orders, then waited weeks for their goods to arrive. Local lore has it that Henry Pigott ordered paint, in a buff color, from the Sears catalog. When it arrived weeks later, the package contained pink paint instead. Rather than returning it, then waiting for it to arrive again, Pigott settled for pink. And that was the color his house stayed until the Park Service restored it to its original buff color several years ago.

Charles McNeill, Director of the Hampton Mariners Museum, likes to tell a story about his friend Henry Pigott. It seems that a magazine reporter from New York was writing a story about Portsmouth. McNeill showed her around the island and introduced her to Pigott.

The reporter began to criticize Pigott's lifestyle on the island, telling him he was crazy to live among all the mosquitoes, with no electricity and no running water.

Pigott thought for a moment, then replied that he had done some traveling. He had even been to New York. And, he had seen all the modern innovations. Then, says McNeill, Pigott paused and added, "And, I'm not sure which one of us is crazy." Such is the attitude of a true Portsmouth villager.

Babb says the mainlanders are soft. "It can get awful hot and the mosquitoes are bad. But they're bad here, too (in Beaufort). I never put a bit of bug spray on me. Those park rangers—well, I tell them they're timid," she says.

Babb scoffs at those who want to know what it was like to live on Portsmouth during Hurricane Hazel. "Storms—well, I was there through most all of them we had. 1944 was the worst one. It was a hurricane and I mean a bad one. There were ten-and-a-half inches of water in the house. But everybody wants to know about Hazel. It wasn't bad at all."

With the death of Henry Pigott, Babb and her aunt were alone on the island. When they decided to pack up and leave in 1971, Portsmouth was a village without a population.

But then Margaret Willis adopted the village as her home. From 1974 to 1977, she was the lone inhabitant of the village. Her home—the one-room schoolhouse. Her only companion—a dog.

Margaret likes to tell a story of how she enjoyed all the niceties of home at Portsmouth. She had coal for her stove, an inside toilet, a tub, and water in the cistern. Tiring of being alone, she left to visit her parents in Ocracoke. She arrived about the same time as a snow and ice storm. "There I was with no heat, no lights. I had left all the luxuries of Portsmouth behind."

Margaret was married on Portsmouth Island and her daughter, Caroline, was baptized there. These days, she's living in Sea Level, but she still holds a lease on a house in the village.

Margaret describes the allure of Portsmouth Village: "It's the peace, not necessarily being alone," she says. She was frightened only once in her three years on the island. She opened the door of the schoolhouse one night to let her dog outside. "It was like looking into a black hole. There was no moon, no stars. I couldn't see anything. I felt like I was in the middle of a void. I closed the door and for the very first time, I locked it."

While Margaret lived on the island, the Park Service paid her \$2.50 a day for serving as a volunteer. She watched for vandals and mowed the grass at about half the village houses.

Money wasn't important on Portsmouth, says Willis. "It's amazing how little you need." She estimates it took her about \$150 a month to live. And, if she were a seafood lover, her cost of living would have been considerably less, she adds.

Folks with ties to Portsmouth are sensitive to the labels that have been attached to the village. "People can call it abandoned or deserted, but it's not dead until it's forgotten. Portsmouth is more of a state of mind. It's the love the people have for the village that really keeps it going. The Park Service can paint the buildings and restore as much as they can. But, it's the love of the descendents that will hold it together," says Willis.

*—Nancy Davis*



# The abandoned communities of Shackleford Banks

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The Cape. Diamond City. Sam Windsor's Lump. Wade's Shore. Whale Creek. Guthrie's Hammock. Mullet Pond.

The names of these communities ring with the sound of fiction and fantasy. But, in fact, they were once as real as Beaufort and Wilmington are today. These communities dotted the shores of Shackleford Banks before the turn of the century. And families with names like Lewis, Davis, Guthrie, Chadwick, Willis, Rose, Wade and Moore eked out an existence along their shores, often battling the vagaries of the sea.

But it was the sea that drew people to settle Shackleford's shores around 1700. Whales, which were common in the waters off Cape Lookout, attracted Shackleford's earliest settlers. But the bank's first whalers never left the shore to make their catch. They depended on beached whales for their livelihood, wrote John Lawson in his 1714 history of North Carolina. They used no boats or harpoons like their northern neighbors.

But northern whalers soon ventured south to teach their counterparts a few whaling lessons. They lived in crude huts built between the dunes during whaling season. When a whale was sighted, they shoved off in their whaling boats, using harpoons to make the kill. Eventually some of these whalers decided to move their families to Shackleford. The Chadwick family along coastal North Carolina are descendents of a northern whaling family that moved south.

On early maps of North Carolina, the whaling village at Shackleford was called Whaler's Hutts. It would be another century before the village would be named Diamond City.

But Shackleford Banks may not have been populated entirely with whalers. Beaufort historian Grayden Paul says that North Carolina's most famous pirate, Edward Teach or Blackbeard as he was more commonly called, may have left some of his marauders on Shackleford Banks in 1718. Paul says that Teach left one boat in need of repairs in Cape Lookout Bay, while he traveled to Edenton for his yearly rendezvous with Governor Eden. The plan called for Teach to pick up the boat and crew on his way south. But Teach was captured and killed. Paul says the crew decided to give up their pirating ways and settle down on Shackleford Banks.

And just as Blackbeard used Cape Lookout's bay to harbor his crew, other privateers and pirates used the sheltered bay. To stop such use, several of North Carolina's royal governors appealed to the crown for money to construct a fort at the cape. But all pleas were ignored. In 1777, the Continental Congress considered building defenses at the cape. Again the consideration amounted to only talk.

But a spunky Frenchman, Captain de Cottineau de Kerloguen, finally made the fort a reality in 1778. Cottineau, bound for the colonies in an armed frigate, met with a chase from several ships of the British Royal Navy. To evade his pursuers, Cottineau sailed into Cape Lookout Bay, assuming the whalers' huts were part of a colonial fort that could offer him protection.

Cottineau was dismayed to find no fortress at the cape, says William Pohoresky, a Newport historian and writer. To remedy that oversight, Cottineau quickly wrote the North Carolina General Assembly, informing them of his plans to build a fort near the whalers' huts, which overlooked the entrance to Cape Lookout Bay.

With the help of the men from his frigate, Cottineau began to build the fort. On April 23, 1778, the North Carolina General Assembly authorized the fortification of Cape Lookout Bay and provided 5,000 pounds to pay for the construction. Cottineau outfitted the fort with guns from his frigate because arms were scarce. The fort was called Fort Hancock after Enoch Hancock, the man who owned the land the whaling village and fort were built upon.

After completion of the fort, Cottineau sailed on to play a larger role in history. He and his frigate fought at the side of John Paul Jones and the *Bonhomme Richard* in that famous naval battle where Jones uttered, "I have not yet begun to fight."

No one knows whether Fort Hancock ever saw any Revolutionary War action, but on May 4, 1780, the state senate ordered the "colors" to be lowered over the fort. Nothing remains of the fort today. Only through colonial histories can its existence be traced.

After the war, the Shackleford Bankers continued to depend on the sea for their livelihood. Though

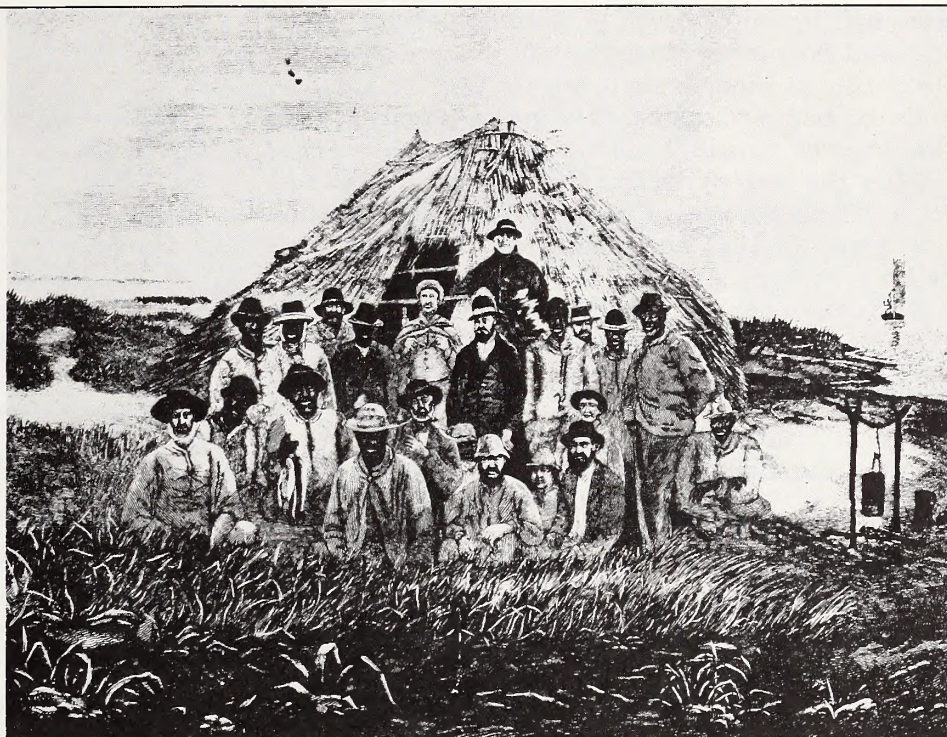


*Launching the boat for a nighttime rescue*



## A Mullet Camp

*During the fall mullet runs, the Bankers set up temporary camps made of small thatched huts near the beach. Using nets 150 and 200 yards long, the fishermen seined the nearshore waters. After making the catch, the Bankers would clean, salt and pack the mullet in barrels for shipment to inland markets.*



whaling was limited to four months a year, it provided the Bankers with a profitable income. One whale could yield from \$1,000 to \$2,000 in whalebone and oil. The oil was used as fuel for lamps. The bone was shaped into corsets, dress hoops and umbrella ribs. The remainder of the whale was sold for fertilizer.

The Bankers also caught porpoises for processing in a small factory that was located on Shackelford Banks. Like the whales, the porpoises yielded large quantities of oil that could be used to fuel lamps.

The mullet fishery proved to be profitable for the Bankers. The Cape Lookout Bight formed a natural trap that supplied the banker fishermen with an abundance of mullet and other fish. Salted mullet became a specialty that made the Bankers famous all along the East coast. They took special care in cleaning, salting and packing the mullet.

While Cape Lookout became noted for its abundance of fish, it also garnered less favorable recognition as a treacherous shoreline. And added to the danger of the shoals was the fact that the profile of the land was so low that even in clear weather a ship might be on the shoals before the captain realized his vessel was close to land.

To aid mariners in their navigation of the cape, Congress authorized the erection of a lighthouse. The lighthouse was completed in 1812 and consisted of two towers, one brick and the other wooden. The wooden building was painted in red-and-white horizontal stripes.

Mariners soon found fault with this lighthouse, saying its structure was too short to make its light visible for long distances at sea. In answer to complaints, the

Lighthouse board authorized a taller tower, which was completed in 1859 and built of red brick. It would be sixteen years before the lighthouse was painted in its now familiar black-and-white diamond pattern. Diamond City was named for the diamond-patterned Cape Lookout lighthouse in whose shadow it stood.

But even the beams of the lighthouse couldn't save the crew of the *Crissie Wright*, which ran aground just off Wade's Shore on a cold January night in 1886. The *Crissie Wright*, a schooner bearing a crew of seven men and a cargo of phosphate, was sailing for her home port of New York City when she was caught in a blistery southwester. The captain decided to take refuge from the storm in Cape Lookout Bay. But as the schooner approached the hook of the cape, the wind shifted and pushed the vessel into the shore.

The *Crissie Wright* was broached larboard side-to and taking on water fast when the captain gave the order for the crew to lash themselves to the mast and riggings. During the night the wind shifted to the northeast and the temperature dropped to eight degrees above zero.

At daybreak the wreck was sighted from shore. The Bankers quickly gathered and made numerous attempts to launch their whaling boats into the surf. But stiff winds and 10-foot waves pushed the boats back at every attempt.

A huge bonfire was built to keep the rescuers warm and to signal the men on the *Crissie Wright* that efforts were being made to save them. But it would be the next day before the winds calmed and a rescue could be accomplished. By then, all but one of the

*Continued on next page*



crew had frozen to death or been swallowed by the sea. And even today when the temperature drops and the northeast winds begin to howl in Carteret County, folks can be heard saying, "It's gonna get colder than the time the Crissie Wright went ashore."

After the tragedy for the Crissie Wright, the need for a life-saving station became apparent. A station was begun in 1887 and completed in 1888 on Core Banks.

With the approach of the twentieth century, the Bankers began to see a change in their island environment. Two hurricanes swept across Shackleford and Core Banks in 1878. In 1879, a hurricane packing winds of 168 miles per hour, lashed the North Carolina coast. In a report of the 1879 hurricane, it was written that "on the Outer Banks the storm caused great destruction at Diamond City . . ."

The thick maritime forest, which covered much of Shackleford and Core Banks, began dying from the effects of the storms. The sand began creeping over the dunes and killing much of the underbrush. Soon vegetables refused to grow and the fruit trees began dying.

In 1897, three more hurricanes hit the coast. But the last straw came in 1899 when a slow-moving August hurricane whirled its way up the Outer Banks, bringing with it 120- to 140-mile-per-hour winds. Several houses along Shackleford Banks were destroyed; others were severely damaged. Many of the Banker's cattle and sheep drowned.

After this hurricane, many Bankers moved their families, their belongings and their homes, plank by



*The diamond-patterned Cape Lookout Lighthouse*

plank, to Harkers Island and The Promised Land, an area of Morehead City. Yet another hurricane ravaged the banks in October, 1899. Only a few families remained on Shackleford after the 1899 hurricanes and all of these would eventually move away.

—Kathy Hart

## A look back at life on the Banks

Ninety-one-year-old Alan Moore, Uncle Alan to his friends, remembers Diamond City and the communities of Shackleford Banks first hand. Moore was born on Shackleford Banks, three to four miles west of Diamond City. He lived there for twenty years before moving to Harkers Island.

Moore remembers Diamond City as a tightly clustered group of homes and a few stores. "There were about 35 or 40 houses," he says. "You could stand in the door of one house and talk with all of your neighbors."

A community house was used for church gatherings and school. Nettie Murrill, a Morehead City resident whose family lived on the banks for generations, says school was held for

three months each year during the summer. There was no resident teacher, minister or doctor. "They doctored with herbs and Indian cure-alls," she says.

Social life and entertainment were limited, says Lillian Davis, a Harkers Island native. Davis has compiled a local history of Shackleford Banks. During summer the families often walked to the beach on moonlit nights, she writes. The adults talked among themselves, while the children played tag in the surf. On summer Sundays, people came from the mainland to church services and revival meetings.

Like the pioneers who settled the west, the Bankers survived by learning how to "make do" with what was

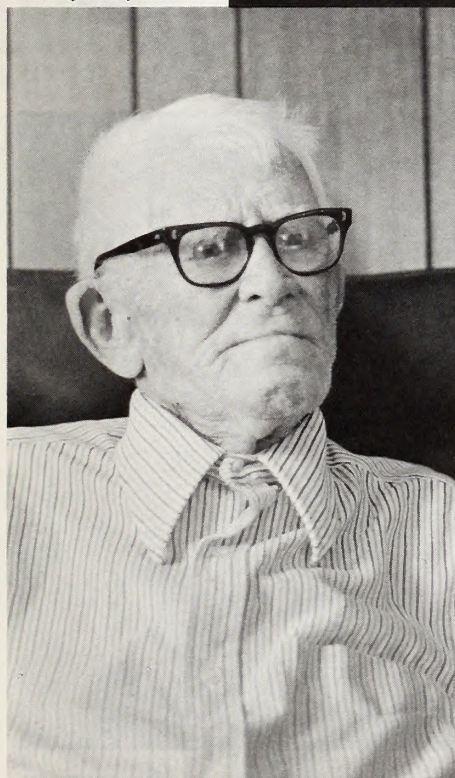
available. And fish and seafood were readily available and free for the taking. The Bankers ate oysters, clams, crabs, mullet and other fish. Shackleford women were known as excellent seafood cooks, Davis says.

Besides seafood, the Bankers had small gardens where they grew collard greens, sweet potatoes, Irish potatoes and onions. They also owned pigs, cows, sheep and goats.

Marcus Hepburn, a sociologist and former Sea Grant researcher, says the Bankers ate a wide variety of birds and waterfowl. Hepburn spent two years living on Harkers Island, delving into the history and sociology of the island residents. Many islanders told Hepburn of their family histories, which



Photo by Kathy Hart



*From his Harkers Island home, Alan Moore points to his native "Banks"*

more often than not included a relative from Shackleford Banks.

"They ate loons and a bird they called a teetee bird, which was some kind of sparrow," Hepburn says. "They ate robins. I've often heard they prepared a dish called 'rice and robins.'"

For drinking water, the people of Shackleford Banks built wells by sinking two or three large pork barrels into the ground, Moore says. They dipped the water out with a long stick which had a bucket at the end.

The Bankers sold salted mullet and whale oil to buy necessities such as cloth, flour and coffee. Moore says the coffee was bought green. It had to be parched in an iron pot over a low fire

and then beat into small pieces for brewing.

Moore remembers how the lush maritime forest, thick with cedars, oaks and pines, once covered the island. The Bankers' homes, built from forest timbers or wreck lumber, sat on stilts that lifted them off the ground. Hepburn says the Bankers piled empty clam and oyster shells beneath their houses to prevent the wind from cupping under the house during storms.

And no talk of Diamond City would be complete without mention of whaling. The Bankers grouped together in crews for whaling season, which lasted from Christmas until April. One crew member kept a constant watch for the giant mammals from a "crows nest" established on the tallest dune.

When a whale was sighted, a crew of six to eight men would run into the surf carrying their 22-foot whale boat, or pilot boat as it was called. The pilot boats were light-weight, sturdy vessels with lapstraked hulls. Once in the water, the pilot boats were propelled by oars and sails.

The whalers used harpoons and harpoon guns to make their kill. The most accurate man with the harpoon was

always stationed at the head of the boat; another at the stern. Once the harpoons were fired and the whale began its struggle for life, the crew and boat were always in danger of being struck by the whale's lashing tail.

After a kill was made, the whale was pulled to shore. Huge chunks of blubber were cut from the whale and taken to a board where they were sliced into smaller pieces. The small pieces were cooked in iron pots to release their oil. The oil was skimmed from the surface of the boiling pot. The cooked blubber was removed from the pot, squeezed for its last drop of oil, and thrown in the pot's fire for fuel. This process was called "trying out" the whale and it could take from one to two weeks to complete.

The Bankers liked to name the whales they killed. One whale caught in May was dubbed Mayflower. Another was named "The Little Children" because it was captured by a group of young boys. And for lack of good name, one whale received the title of "Haint Bin Named Yet."

Moore says he made one whaling trip with his father, but didn't enjoy

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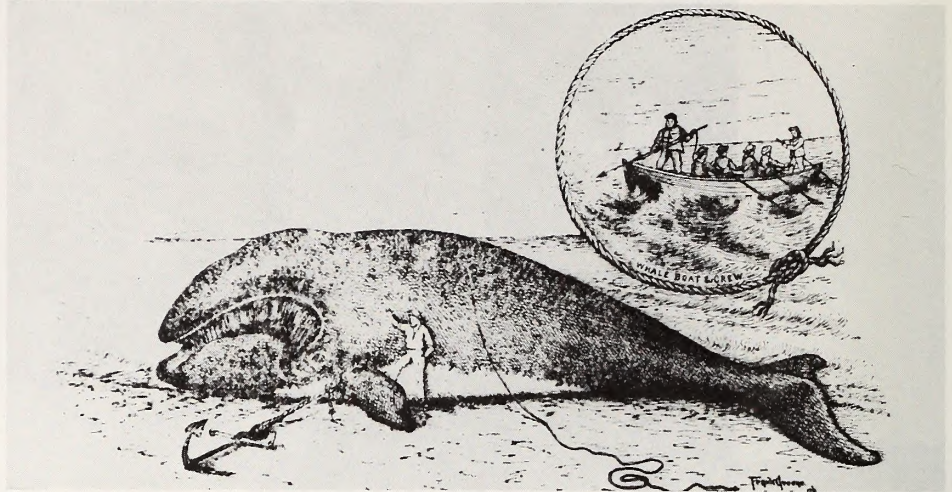
the activity. "As long as I could see the whale I was satisfied," Moore says. "But I was scared when the whale went under because you didn't know where it was going to surface."

Some say the whaling activities of the Bankers have been overglamorized. And indeed it was just one of the ways the Bankers made their living. Moore says he ran fish to market and raised sheep to sustain himself. The sheep ran free on the island and were rounded up each summer for shearing, Moore says. The fine silky wool was sold to Leaksville Woolen Mills, outside of Charlotte, where it was woven into blankets.

But Murrill says the poor Banker families could not afford to own sheep. She remembers her uncle saying that when a poor family needed wool for socks the mother would send her children to chase a few sheep through the briars. "Some of the sheep's wool would snag on the briars, where it could be collected for weaving," Murrill says.

Before Barden's Inlet was carved by a 1933 hurricane, Bankers could walk from Shackleford to Core Banks. Moore says a storm caught him and his father by surprise while they were crabbing along Core Banks. Strong winds and a frothy sound forced the pair to walk home. They walked 17 miles, passing the lighthouse and Diamond City, before reaching home, Moore says. "Mama was standing out in the rain watching for us when we came into sight," he says. "I've never seen anyone happier to see two bodies than Mama was to see us that night."

—Kathy Hart



One whale yielded as much as \$2,000 in oil and bone



Divine Guthrie, a Shackleford boatbuilder, near the turn of the century

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—State government

—University professor/researcher

—Other \_\_\_\_\_

Coastal property owner ☐ yes ☐ no Boat owner ☐ yes ☐ no



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



What's tougher than a pier piling made out of steel and covered with concrete? Spencer Rogers, Sea Grant's coastal engineering specialist, says the answer is plastic.

Rogers says a new method of constructing piles for piers and marina docks uses a PVC pipe as a casing that is filled with concrete reinforced with steel.

While the initial cost is slightly higher than concrete construction, Rogers says the long-term cost is probably less expensive. The PVC piles require less maintenance and they last longer.

A wooden pile has a lifetime of about 30 years, but the PVC piles have lasted up to 50 years. And, they're stronger than a concrete pile of the same size. In the conventional concrete piles, water penetrates the concrete to rust the steel inside, causing the concrete to crack.

Rogers says the new method is useful for new construction as well as for repair work on docks using the older, conventional methods.

UNC Sea Grant Director B.J. Copeland was elected to the Board of Directors for the Marine Division of the National Association of State Universities and Land-Grant Colleges (NASULGC). Copeland was one of two Sea Grant directors elected to the board.

Dirk Frankenberg, director of the marine science curriculum at the Uni-

versity of North Carolina at Chapel Hill and coordinator for UNC Sea Grant's coastal studies research, was also elected to the board.



Jim Bahen, a Sea Grant marine advisory agent at Ft. Fisher, is testing an excluder trawl for shrimping. Working with a local shrimper who has agreed to use the trawl, Bahen will compare the catch results from the excluder trawl with those of a standard trawl.

An excluder trawl has two tailbags and a mesh panel in the belly of the net. As the trawl is dragged along, the catch enters the mouth of the net. The shrimp will pass through the mesh of the panel and into the main tailbag. Bycatch, such as fish, jellyfish and crabs, will strike the panel and be forced into the other tailbag, which can be left open so that the fish can pass back into the water.

The excluder trawl is designed to extend the vessel towing time and free many of the juvenile fish and shellfish that often die in the trawl.



The blue crab grows only periodically through a molting process, called shedding. For a period of several hours after shedding, the hard blue crab, including its shell, appendages and internal parts, is soft. We know the crab in this soft state as a delicacy. And, fishermen can land extra profits if they're willing to cull out peelers (crabs preparing to shed) and hold them until they shed. With a plentiful supply of crabs in North Carolina's waters, more fishermen are giving soft-shell crabbing a try.

That's why UNC Sea Grant is sponsoring a soft-shell crab workshop. The workshop will be held March 10 from 10 a.m. to 4 p.m., at the Beaufort

County Community College in Washington. Experienced shedders will be on hand to tell fishermen about their successful shedding methods. The workshop will include discussions on blue crab biology, peeler identification, harvesting methods, facility design and marketing. Fishermen will find out what it costs to get into the business and what the potential return is.

The fee for the workshop is \$5 in advance and \$6 at the door. For a complete agenda and a registration form, write Jim Murray, UNC Sea Grant, 105 1911 Building, North Carolina State University, Box 8605, Raleigh, N.C. 27695-8605 or call (919) 737-2454.



Do you need a new engine for your shrimp trawler, but you can't decide what to buy? Attend the North Carolina Commercial Fishing Show, March 16, 17 and 18, at the Crystal Coast Civic Center in Morehead City. Manufacturers and dealers will be on hand with the latest in boats, nets, engines, motors, traps, pots and accessory gear.

The show will be open 6 to 9 p.m., Friday, March 16; 10 a.m. to 5 p.m., Saturday, March 17; and 11 a.m. to 5 p.m., Sunday, March 18. Admission is free. The Crystal Coast Civic Center is located off U.S. 70 in Morehead City, on the campus of Carteret Technical College.

A series of short seminars will be presented throughout the three-day event. Seminar topics will cover everything from crab shedding to the prevention of boat fouling.

The North Carolina Commercial Fishing Show is sponsored by UNC Sea Grant, the N.C. Agricultural Extension Program, the N.C. Division of Marine Fisheries, the N.C. Fisheries Association and Carteret Technical College.

*Continued on next page*





Where do the 1984 gubernatorial candidates stand on the development of North Carolina's outer continental shelf? On the stabilization of Oregon Inlet? On submerged land ownership?

You can find out. The North Carolina Marine Science Council is sponsoring a public forum March 5, at 7 p.m. in the auditorium of the Archives and History Building, 109 East Jones St., Raleigh. During the forum each candidate will be given 15 minutes to address the important coastal and marine issues facing North Carolina's next governor. Besides the topics mentioned above, candidates will be asked to address the issues of peat mining and land drainage on the Albemarle-Pamlico peninsula, and the promotion of North Carolina's fisheries products.



Sea Grant researchers Donald Stanley, Bob Christian and Hans Paerl recently met with representatives of governments from Washington, D.C. and surrounding communities to discuss the algae blooms on the Potomac River and on the Neuse and Chowan Rivers in North Carolina. Christian says they found a lot of similarities in the problems of the three rivers.

All three rivers have a large number

of point source polluters. Each river "bloomed" at about the same time during the summer of 1983. And, each of the rivers had a low river flow at the time of the bloom. As the salt water began to intrude up into the river, there was a rapid decline of the bloom on all the rivers, says Christian.

Christian says that while environmental managers in the D.C. area rely on an elaborate computer model to predict and monitor blooms, researchers in North Carolina have the advantage of doing more experimental work to understand the process of an algae bloom.



The North Carolina Coastal Resources Commission recently adopted a mitigation policy. Now, development that occurs within the jurisdiction of the Coast-

al Area Management Act may be eligible for mitigation, says Walter Clark, Sea Grant's coastal law specialist.

Clark says that in the natural resources context, mitigation means the trading of one valuable resource for another resource of equal or greater value. For example, suppose a waterfront property owner wants to excavate some coastal wetland to gain boat access to deep water. The owner applies to the state for a permit, but the permit is denied based on the permanent loss to the wetland.

Under the new mitigation policy,

the property owner can offer another resource in exchange for the resource lost. In this case, the owner might offer to create additional marsh by lowering other high-ground property to marsh elevation. And, if the Commission accepted the offer, the owner could complete his project.

If you'd like more information on mitigation, contact Clark at (919) 737-2454.

Tom Blevins, a North Carolina State University zoology graduate, has joined the staff at the Sea Grant Aquaculture Research and Demonstration Center in Aurora. Blevins will assist Sea Grant marine advisory agent Randy Rouse with his aquaculture work.

Before coming to Sea Grant, Blevins worked with Sea Grant researcher Howard Kerby on his striped bass project.

If you'd like to contact Blevins, call (919) 322-4054.

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## COASTWATCH

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# COAST WATCH

## Squid: from tall tales to the table



From the window of the Nautilus, a giant squid

*It swam backward toward the "Nautilus" and at great speed, watching us the while with its huge staring green eyes. Its eight arms (or rather, feet) were twice as long as its body and twisted like the snakes in the Furies' hair. . . . The monster's mouth, a horned beak like a parrot's, opened and shut vertically. Its tongue was of horn substance and furnished with several rows of pointed teeth. It came forth quivering from this veritable pair of shears. What a freak of nature it seemed, a bird's beak on a mollusk!—Jules Verne, *Twenty Thousand Leagues Under the Sea**

"It was an immense cuttlefish," writes Jules Verne. But modern biology would identify this freakish creature, trying its best to devour the *Nautilus*, as a giant squid. And indeed, the yarns of mariners and the literature of poets and writers throughout the ages are peppered with accounts of the giant squid—often endowed with a ferocious nature and the strength to pull large vessels beneath the waves.

While writers and mariners enhanced the size, ferocity and abilities of the squid, the real life and biology of the squid may be stranger than fiction. After all, the squid possesses eyes like a

*Continued on next page*



human, fins like a fish, arms like an octopus, a beak like a bird, and power like a jet.

The giant squid, found worldwide, can reach an overall length of 60 feet and weigh as much as two tons. Scientists are just beginning to delve into the biology of this mysterious and illusive deep-sea creature. Researchers believe their populations may be on the increase because the populations of their major predator, the sperm whale, are declining.

But it's not the giant squid that fills the nets and snags the jigs of fishermen from Japan, northern Europe, Spain, South America, Mexico and now, the United States. The giant squid is not tasty at all, but many of the smaller species are. Squid is a prized seafood in southern Europe, Africa and the Far East.

The squid is a mollusk, a phylum of creatures which includes the clam, whelk and conch. Unlike its cousins, the squid has no visible shell. But imbedded in the mantle is a soft internal plate called a pen, the remains of a once more developed shell.

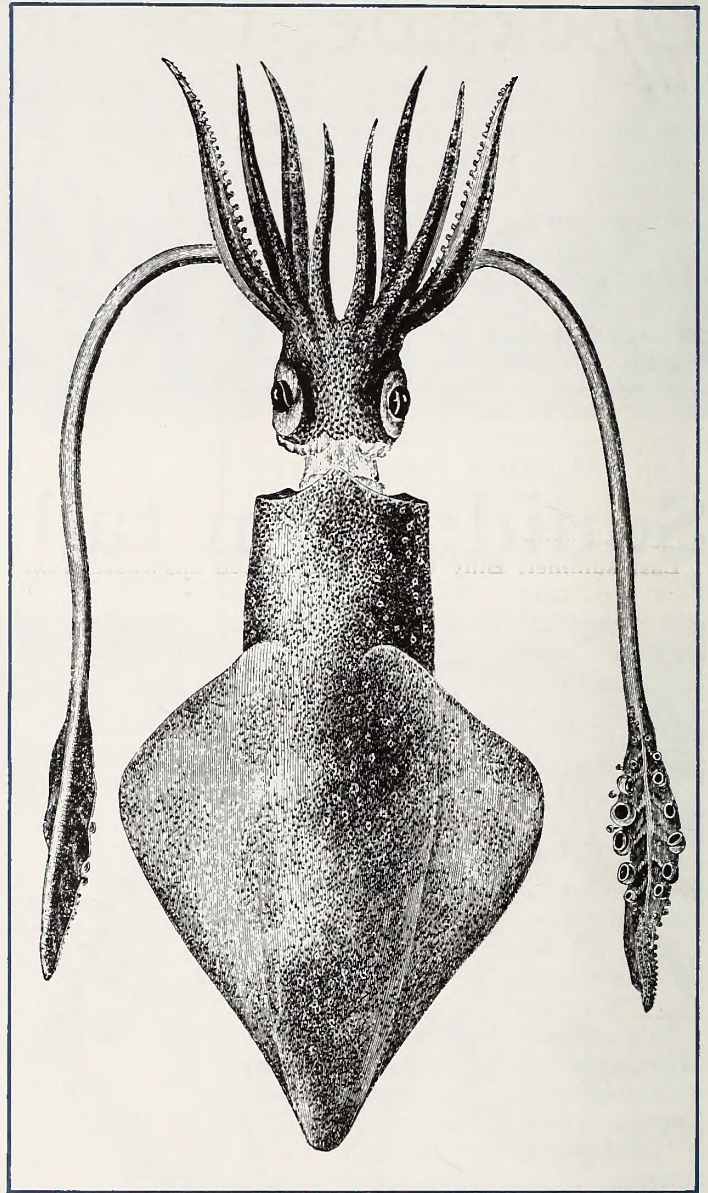
Along with the octopus, cuttlefish and nautilus, the squid belongs to the cephalopod class, which means its arms extend from its head. From the squid's head flow eight arms and two tentacles. The inner surface of each arm is flattened and covered with stalked, cup-shaped adhesive discs that act as suction cups. Suckers also are found on the flattened ends of the tentacles. The highly mobile tentacles seize the squid's prey, which is drawn toward the mouth; the arms aid in holding the prey.

Squid, which are carnivorous, eat crabs, fish and even other squid. The mollusks dart into a school of fish, seize their prey, and bite a chunk out of the fish's neck, severing the nerve chord and killing it instantly.

In a world of "eat and be eaten," the squid also is prey for many ocean creatures—sharks, whales and swordfish. But two defense mechanisms help many squid survive. The squid can change the color of its body to blend with its background. And squid can emit an inky cloud of fluid which creates a screen for escape.

Squid are among the ocean's fastest swimmers as they jet propel themselves forward and backward. The mantle muscles of many large squid are so powerful that when they contract and force out a jet of water, it is like a blast from a fire hose.

The squid also possesses giant nerve fibers in its mantle which allow it to carry messages at a rate



*One of many species of squid*

of 50 miles an hour. (The nerve fibers in humans carry messages at a rate of  $4\frac{1}{2}$  miles per hour.) A squid can sense danger and jet off in five-hundredths of a second.

And if you get a chance to look a squid in the eye, it may see you almost as well as you see it. Squid, which are equipped with a camera eye much like a human's, see better than any other animal without a backbone and better than many that do have backbones.

While scientists know a lot about the anatomy of the squid, they know very little about the habitat preference and breeding habits of the many species of squid that live in the oceans.

—Kathy Hart



# Dockside, the new catch is squid

G.R. "Moon" Tillet and his son, Billy Carl Tillet, two Wanchese fishermen, know how to catch all the squid they want. But the problem comes in finding a market for the eight-armed mollusks.

In the summer, the Tilletts net what they commonly call "summer squid" or *Illex*. In the winter, it's "winter squid" or *Loligo*. Last summer was the first time the Tilletts had fished specifically for squid. This winter they're catching the cephalopods as a bycatch.

Billy Carl Tillet captains the boat, the *Linda Gayle*, while his father mans the telephones, negotiating the prices their catch will bring. The Tilletts get an average of 20 cents a pound for summer squid and 35 cents a pound for winter squid. "They tell us they're using the summer squid for bait," says Moon Tillet. "But I know those squid have some food value."

Last summer, Billy Carl Tillet netted anywhere from 7,000 to 60,000 pounds of squid in a two-day trip. His father says their records show that between July and October they caught over one million pounds of squid. "We had the best fishing summer ever," says Billy Carl Tillet. "It was profitable and showed us something else we could do. It was better than trying to shrimp around here, where you make just enough to keep your head above water."

In 1981, North Carolina fishermen landed 278,290 pounds of squid in this state with a dockside value of \$91,652. In 1982, 135,935 pounds of squid were landed for a dockside total of \$43,884. Figures for the 1983 catch were not available from the N.C. Division of Marine Fisheries, but Moon Tillet estimates that Wanchese fishermen netted between four million and five million pounds of the mollusks last year.

In a management plan approved in December 1983, the Mid-Atlantic Fishery Management Council in cooperation with the National Marine Fisheries Service, the New England Fishery Management Council and the South Atlantic Fishery Management Council, set the allowable catch for the *Loligo* fishery at 44,000 metric tons and the *Illex* fishery at 30,000 metric tons. The allowable catch is reassessed yearly and can be modified if biological circumstances warrant.

Most North Carolina fishermen trawl for squid. Billy Carl Tillet uses a fly net lined with a shrimp net. The wide-mouth net herds the squid into the tailbag. The cost of outfitting their boat for squid was minimal since the Tilletts already owned their nets. "We didn't want to sink money into fishing for squid until we knew the fishery would pay off," says Billy Carl Tillet.

Kenny Daniels, who owns a neighboring fish company, faced marketing problems when he entered the fishery a few years earlier. In 1979 Daniels equipped one of his boats with an onboard blast freezer. His crew froze the squid as soon as it was caught and washed, just as the foreign fleets do. "We had a beautiful product," Daniels says. "But we couldn't get rid of it. We couldn't find a market for it."

But Daniels is ready to try again. He plans to outfit two more vessels with onboard freezers to complete a fleet of three boats that will fish for squid this summer. Daniels says he will do his own marketing, hoping to sell his frozen product to a restaurant or supermarket chain.

By freezing onboard, Daniels has eliminated one problem that faces the Tilletts—spoilage. The Tilletts have no onboard freezer so they must quickly ice their catch and head for port. They've learned two days is the maximum time they have at sea during hot summer days. During the 1983 summer when Oregon Inlet was unnavigable, the Tilletts delivered their squid to a seafood distributor in Virginia. This winter the inlet is open, and the Tilletts are bringing their catch home to Wanchese.

To locate schools of squid along the ocean floor, Billy Carl Tillet uses a white-line depth recorder with a scope. But he admits even fancy electronics don't always turn up a bountiful catch. He would like to know more about the squid's habits—how they're affected by weather and currents.

In January, UNC Sea Grant and the South Atlantic Fishery Development Foundation sponsored a workshop in Manteo to help fishermen learn more about how to fish, handle and market the mollusks. Gilbert Voss, a teuthologist (a scientist who studies cephalopods) at the University of Miami, told an audience of 30 fishermen that there are four kinds of squid found along the North Carolina coast—*Loligo paelei*, sometimes called the longfin or winter squid; *Doryteuthis plei* or arrow squid; *Lolliguncula brevis* or brief squid; and *Illex illecebrosus*, called the shortfin or summer squid.

Warren Rathjen of the National Marine Fisheries Service's Gloucester, Massachusetts office, says a fisherman's past experience will be his most valuable tool in predicting the location of squid during certain seasons of the year.

*Continued on next page*

*Photo by Kathy Hart*



*Billy Carl Tillet on the Wanchese docks*

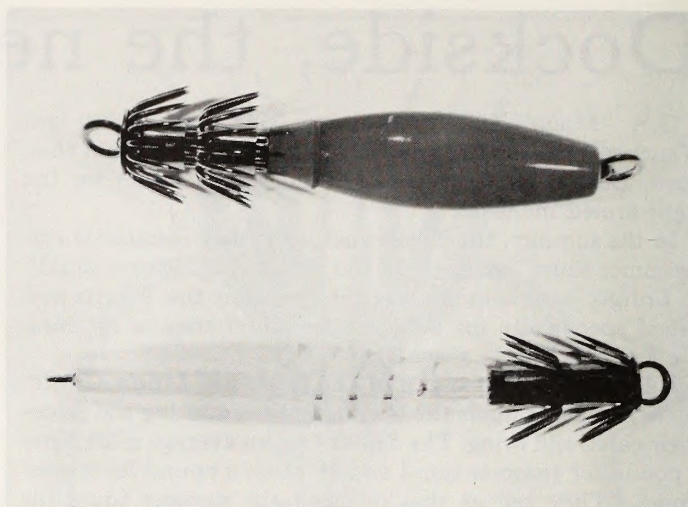


"The time of day has a definite impact on the production of squid, but dependent on what type of gear or fishing approach you use," Rathjen says. "If you're using bottom trawls, they're likely to be most effective during the time of day when there's bright light. The squid would be expected to be close to the bottom then. Characteristically squid will move off the bottom during hours of darkness."

At night, Rathjen says another method, squid jigging, frequently used by the Japanese, is more productive. An automated squid jig is used along with a light that is immersed in the water to attract small fishes and crabs, which in turn attract squid. The automatic jig consists of a reel, a roller and a strong monofilament line weighted at the end and rigged with a series of six to 10 squid jigs about three feet apart. A squid jig is a circle of barbless hooks, which snag the mollusks as the line is moved up and down. Jigging results in less damage to harvested squid than trawling, which sometimes crushes and tears the cephalopods.

In fishing experiments conducted by the New York Sea Grant Extension Program, fishermen and extension specialists learned that the squid jigging devices caught limited quantities of *Loligo* squid, but worked well for catching *Illex* squid. Converting a 50-foot boat for squid jigging costs between \$10,000 and \$30,000. Advisory agents concluded that until a stronger market for *Illex* squid developed and a higher quality harvest demanded, conversion to squid jigging was not economically sound.

Voss says the greatest potential for the U.S. squid fishery lies in the harvest of the brief squid, which prefers an inshore habitat. "I really think that the small inshore squid has tremendous promise because it occurs in large numbers," Voss says. "It's close in, so we don't have long runs out to the fishing grounds and back. It could be done by bay



*Jigs like these are used to snag squid*

boats. All it would take is to develop a larger market as they have done in Texas, where it is being sold in supermarkets."

Moon Tillett hopes the squid fishery goes the way of the shrimp fishery. "I remember when they brought shrimp in by the netfuls and threw 'em away," he says. "Sixty years ago shrimp just weren't eaten. They called them 'old bugs.' I think squid has the same potential.

"I swore I wouldn't live long enough to eat squid. But I ate a handful last summer fried in the deep fry. They tasted just like clam strips. If they're tender, I don't think you could tell the difference."

—Kathy Hart

## A better image, a bigger market

The squid has an image problem. And it's not just the Jules Verne syndrome. It's the soft body, the eight arms and two tentacles, the big black eyes. And, that name. Squid.

Spaniards eat calamares. Italians eat calamari. The Japanese make ika a part of nearly every meal. But will Americans eat squid? Chances are they will—if marketing succeeds.

For over 30 years, Gilbert Voss, a biologist at the University of Miami, has made squid his business. While you may turn up your nose at mention of the ugly cephalopod, Voss speaks of squid with admiration. He wants us to do more than study the squid; he wants us to eat it.

"Squid is one of the major fisheries of the world, and there are areas in which squid has been eaten since classical times," says Voss. He thinks Americans could learn something from those other nations.

For example, squid is as much a part

of the diet in Japan and Spain as the hamburger is in the United States. Japan is the world's largest squid market, with an annual consumption of about 600,000 tons, over half the world's total squid production. Consumers there pull packages of dry, shredded squid from vending machines. While the Japanese prefer their squid uncooked, they also consume large quantities of squid in dried, cured, salted and canned forms.

In northern Europe and South America, the squid is gaining in popularity. But, so far, in the United States, squid is served mainly as an ethnic food.

Voss says a successful fishery will require a healthy market here in the United States. And, the key to the success of the U.S. market is going to be public acceptance of squid. The way to do that is easy, he says. Get every American to try squid just once.

Some of the hurdles have already

been overcome. Ten years ago, fishermen tossed their incidental catches of squid overboard, or they used them as bait. Now, more and more fishermen are fishing specifically for squid. North Carolina fishermen say they have no problems catching the squid; it's just a matter of finding a market.

A California seafood company has been marketing squid for over 20 years. Pat Flanagan, vice-president of General Fish Corporation in San Francisco, says his company concentrated on a very small market in California, selling mainly to ethnic groups. During that 20-year period, the most squid the company produced was about 500,000 pounds per year. But, Flanagan says they succeeded in establishing a market.

Flanagan believes that restaurants will be the key to the squid's success in this country. Once the cephalopod makes it to the menu, people will begin to accept it, he says.



Red Lobster, a nationwide chain of 370 seafood restaurants, is already promoting squid. Restaurant managers think squid, listed on the menu as calamari, may go the way of the snow crab and popcorn shrimp, two other seafoods made famous by Red Lobster.

In 1983, the chain imported less than half a million pounds of squid for processing into squid rings, says Debby Coudert, Red Lobster public relations representative. The company purchased the squid already cleaned and cut it into rings.

Coudert says the restaurant chain has a panel of researchers who found squid was being offered in other seafood restaurants throughout the country. "And, we're continually looking for new seafood products and ways of tapping other resources in the ocean," Coudert says.

As more and more restaurants begin serving squid, grocery stores will begin to carry it—a key in improving its public perception. Gilbert Bullock, assistant manager of the seafood department of a Big Star store in Raleigh, says squid sells well in his store. The squid is caught in North Carolina waters and shipped to his store daily. Bullock says he sells about 20 pounds each day.

While most of his customers are Oriental or European, some Americans are willing to give squid a try, says Bullock. "The ones who don't know how to cook it are the ones who don't come back," he adds.

Bullock says he has been selling squid for 99 cents per pound for two years—a good buy when compared with other more popular items. Consider the cost of fresh salmon at \$5.99 per pound and flounder fillets at \$2.98 per pound.

As the market for squid grows, the fishery will have to grow with it, says Warren Rathjen, of the National Marine Fisheries Service in Gloucester, Massachusetts. Rathjen says the Japanese squid fishery represents the state of the art. Since World War II, the fishery there has automated to the extent that physical manpower is no longer required, says Rathjen. "We're literally light years behind in our ability to understand how to fish for and use squid," he says.

Even with a healthy domestic market for squid, the United States fishery will ultimately be competing

*"Squid is one of the major fisheries of the world, and there are areas in which squid has been eaten since classical times."*

*—Gilbert Voss*

with other squid-producing nations. This is where the squid will face a foe more formidable than its image, says Voss. "The primary problem in the squid market today is international politics. It's not a lack of demand."

For example, Spain uses a variety of ploys to exclude other countries from becoming their competitors in the squid fishery. They have a large, government-subsidized, high seas fleet. Some of the ships fish within the 200-mile limit off the U.S. coast. By sailing some of those vessels under flags of other countries, they can catch more than the quota they are allowed under their own flag.

At the same time, the Spanish refuse to buy American-caught squid because it would hurt their fishery, says Voss. By placing high taxes on imported squid, they make it too expensive for Spanish companies to buy imported squid. And, they demand sea-frozen squid, virtually excluding all U.S. vessels because few are equipped for such ocean processing.

Japan is equally interested in protecting its fishery from American intrusion. They don't like to buy U.S.-caught squid because they say the squid are not of top quality since they're not jig-caught. While this is partly true, says Voss, the trawl-caught squid could be processed into products that don't require the finest quality. "The idea is to keep the American fishery at a low level so that they can say, 'Well, you can't utilize it, therefore we get the major part of the catch,'" says Voss.

Photo by Kathy Hart

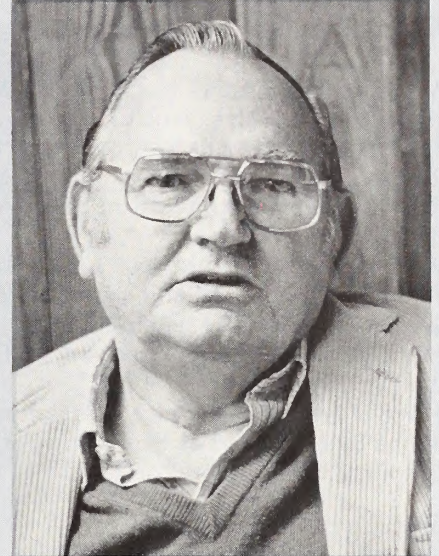
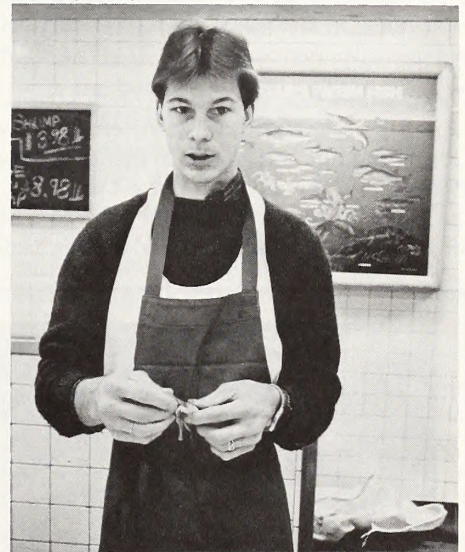


Photo by Nancy Davis



*Gilbert Bullock*

"The market has become very political. To get away from this, we're going to have to have two kinds of markets—a local U.S. market and a foreign market," says Voss.

One possibility for American fishermen trying to break into the foreign market is the joint venture. Under such an arrangement, a U.S. vessel catches the squid and sells it to a foreign vessel, waiting nearby, where the catch is processed at sea. Voss says that fishermen may make some money off of joint ventures, but they may be hurting themselves in the long run. He advises U.S. fishermen to concentrate on developing their fishery to the point where they can catch, process and market their own catches.

*—Nancy Davis*



# More ways than one to cook squid

As a seafood, squid has a long list of virtues. It's nutritious, inexpensive, versatile and easy to prepare. It has a firm texture, it's high in protein and low in fats, and it tastes good. And, as much as 80 percent of the squid is edible—a large amount when compared to most other seafoods.

When purchasing squid, look for signs of freshness. Color spots on the mantle or skin should be distinct and sharp. The color of the mantle should be bright, like fresh fish. The eyes should be clear and bright and the flesh should be firm and without an odor.

Joyce Taylor, Sea Grant's seafood agent at the North Carolina State University Seafood Laboratory in Morehead City, offers these recipes for squid.

## *Fried Squid, Greek Style*

2 lbs. whole squid	1 egg, beaten
2 Tb. lemon juice	2 Tb. milk
1 tsp. salt	1 cup flour
1/8 tsp. white pepper	Fat for frying

Clean squid and cut into 1/4-inch strips. Cut tentacles into 1-inch pieces. Sprinkle with lemon juice, salt and pepper. Combine milk and egg. Dip squid into milk and roll in flour. Place in a single layer in hot oil in skillet. Fry at 350 degrees for 3 to 5 minutes. Turn and fry 3 to 5 minutes more. Drain and serve with lemon wedges. Serves 3 to 4 people.

## *Squid Chowder*

2 lbs. whole squid	1/4 cup chopped parsley
1 cup chopped onion	1 1/2 tsp. salt
1/4 cup cooking oil	3 cups cubed potatoes
1 6-oz. can tomato paste	1 quart water

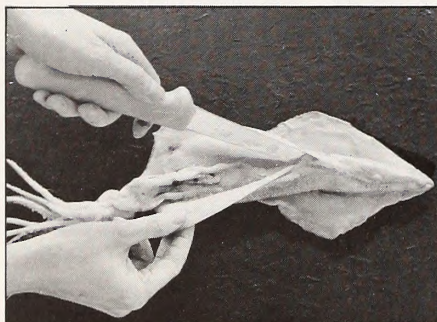
Clean squid and cut mantle into 1/4-inch strips. Cut tentacles into 1-inch pieces. Cook onion in hot oil until tender. Add squid and cook for 5 minutes. Add water, tomato paste, parsley, salt and pepper. Simmer for 10 minutes. Add potatoes. Cover and simmer for 20 to 30 minutes or until potatoes are tender. Stir occasionally. Serve with French bread. Serves 5 to 6 people.

## *Squid Salad*

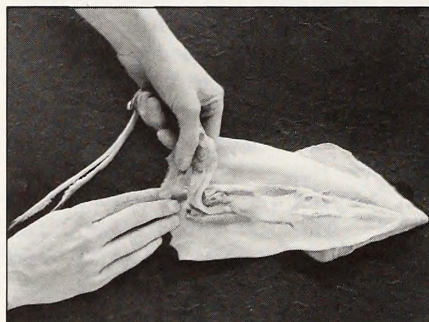
2 lbs. whole squid	1/2 cup chopped red onion
2 cups boiling water	1 clove garlic, crushed
2 tsp. salt	1 Tb. chopped parsley
1/2 cup salad oil	1 tsp. salt
1/4 cup lemon juice	1/4 tsp. pepper
1 cup celery	

Clean squid and cut mantle into 1/2-inch pieces. Place squid in boiling, salted water. Cover and simmer 5 to 10 minutes until tender. Drain and rinse in cold water. Combine remaining ingredients, cover and refrigerate for several hours. Makes about 2 cups.

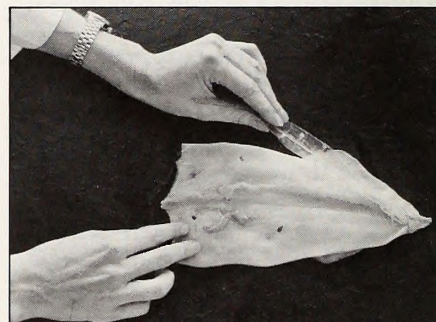
Photos by Steve Wilson



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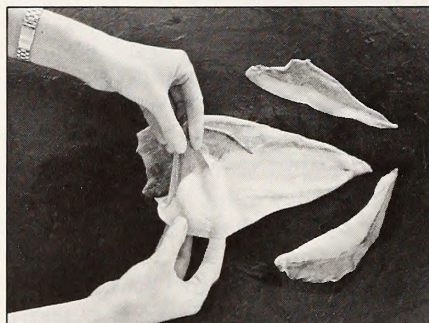
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## *Cleaning a squid*

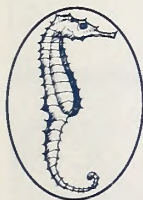
1. Thaw frozen squid. From opening in mantle, cut lengthwise. 2. Spread inside of mantle open flat. Grasp head and arms and pull off intestines. Cut tentacles away from head. 3. Remove pen and

scrap away any remains. 4. Turn mantle to other side. Pull off fins. 5. Remove outer membrane from mantle and fins. 6. Rinse. Cut mantle and fins diagonally into strips.



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).*



In one Manteo classroom, high school students are learning how to hang a gill net, build a crab pot and dig for clams. Marine occupations is the course. And the students enrolled may be tomorrow's fishermen, boatbuilders and charter boat captains.

In the classroom, the students learn about oceanography, marine biology, first aid and boat safety. Outside of the classroom, they learn by doing. "We'd like to say we probably spend at least sixty percent of the time somewhere out on the water or out on the beach," says Algie Campbell, the marine occupations instructor at Manteo High School.

Students learn firsthand how to trawl for shrimp, read a depth recorder and angle for marlin. "Now I can hang a net, and fish with nets and do commercial fishing if I like," says Tammy Holton, a 17-year-old student in the class.

Lundie Spence, UNC Sea Grant's marine education specialist, says more coastal high schools are adding marine occupations to their curriculum. If you would like more information about marine occupations courses, contact Spence at UNC Sea Grant, Box 8605, Raleigh, N.C. 27695-8605. Or call, 919/737-2454.

Sam Thomas, UNC Sea Grant's Seafood Specialist at the NCSU Seafood Laboratory in Morehead City, will conduct a blue crab pasteurization

workshop for industry members on May 10 from 8:30 a.m. to 5 p.m. at the seafood laboratory. Thomas will present the basic principles of pasteurization, including the most up-to-date techniques. He'll also cover regulation requirements and provide guidance in setting up quality control in a crab plant.

For more information, call Thomas at 919/726-7341 or write NCSU Seafood Laboratory, P.O. Drawer 1137, Morehead City, North Carolina 28557.



Those slender, dark, worm-like creatures wiggling their way up North Carolina's coastal rivers are elvers or baby eels. UNC Sea Grant collects the wild elvers to stock ponds at the Aquaculture Research and Demonstration Center in Aurora. But this year, the program needs some help locating the elusive elvers.

Randy Rouse, UNC Sea Grant's aquaculture advisory agent, says the elvers usually accumulate behind dams or spillways—any place that stops their upstream migration. And he adds, that they're usually most visible in the early morning or late evening.

If you see a large concentration of elvers, call Rouse at 919/322-4054.

UNC Sea Grant and the N.C. Marine Resources Center on Roanoke Island are sponsoring a recreational boat show May 12 and 13 at the center in Manteo. The show will feature a complete selection of recreational boats and accessories, with an emphasis on sailing. Educational programs on topics such as boater safety, first aid, hypothermia and boat maintenance will be offered in conjunction with the show.

For more information, contact Rich Novak at 919/473-3937 or write Novak at P.O. Box 699, Manteo, N.C. 27954.



More lawyers today find themselves representing clients on environmental law issues. But because of its newness and complexity, some lawyers find themselves struggling to represent their clients adequately.

That's why UNC Sea Grant, the Institute of Government and the North Carolina Bar Foundation decided to sponsor a conference that would acquaint attorneys with the many facets of environmental law. The conference will be held May 18 and 19 at the Marriott Hotel in Raleigh.

The topics to be addressed at the conference are: common law remedies for environment degradation, administrative procedure and environmental law, water quality, water use rights and conflicts, local planning and zoning, and development in environmentally sensitive areas.

For more information about the conference, contact Walter Clark at UNC Sea Grant, Box 8605, Raleigh, N.C. 27695-8605. Or call, 919/737-2454.



The Rachel Carson National Estuarine Sanctuary will be dedicated April 22 at the Duke University Marine Laboratory on Pivers Island overlooking the sanctuary site. The Rachel Carson Sanctuary is the first site to be dedicated in the N.C. National Estuarine Sanctuary System, a multiple-site system that is part of the National Estuarine Sanctuary Program. The sanctuaries will provide a natural field laboratory for public and scientific study and preserve one of our nation's most valuable ecosystems.

The public is invited to the dedication. For more information, contact Kathy Henderson at the Office of Coastal Management in Raleigh (919/733-2293).

*Continued on next page*





In February the Coastal Resources Commission established an Outer Banks Task Force to study the severe erosion occurring along northern North Carolina beaches. Jay Langfelder, head of the Department of Marine, Earth and Atmospheric Sciences at North Carolina State University (NCSU) and a coordinator for UNC Sea Grant's coastal studies was appointed chairman of the committee.

John Fisher and Margery Overton, two Sea Grant researchers and members of the NCSU Department of Civil Engineering, along with Spencer Rogers, UNC Sea Grant's coastal engineering specialist, are members of the task force's technical subcommittee. The task force is seeking to find the technical solutions and funding necessary to combat the erosion problem.

UNC Sea Grant Director B.J. Copeland is accepting research proposals for the program's 1985-86 funding cycle. If you're a researcher at an academic institution or state agency and would like to submit a proposal, call the Sea Grant office in Raleigh for the necessary forms. The telephone number is 919/737-2454. All proposals must be submitted by May 1.

Frank Thomas, project director for UNC Sea Grant's work at the NCSU Seafood Laboratory in Morehead City, and Joyce Taylor, Sea Grant's marine agent at the lab, have received a grant from the Mid-Atlantic Fisheries Development Foundation to develop a slide show and a script on seafood care and handling. The slide show will be used by extension and advisory agents in the mid-Atlantic states. It will focus on the proper methods of selecting, preserving and dressing fresh seafoods.



March is the beginning of crab-shedding season in North Carolina. If you're thinking of expanding your crab operation to include a crab-shedding facility, you'll want to order *A Guide to Soft-Shell Crabbing*. Written by Wayne Wescott, UNC Sea Grant's advisory agent in Manteo, the 32-page book is designed for the layman who is considering crab shedding. It includes sections on blue crab biology, identifying and handling "peelers," harvesting methods, shedding methods and more.

In addition to diagrams and illustrations, five color photos will depict the various stages of peelers. These photographs will enable the novice to recognize the subtle signs of a blue crab preparing to shed.

For a free copy, write UNC Sea Grant, Box 8605, Raleigh, North Carolina 27695-8605. Ask for publication number UNC-SG-84-01.

*Predictive Growth Model for the Meat Weight (Adductor Muscle) of Bay Scallops in North Carolina* by Robert Kellogg, NCSU Department of Economics and Business, and Dennis Spitsbergen, N.C. Division of Marine Fisheries, develops a model to predict the meat size for bay scallops. The growth model can be used to suggest season openings that will attain optimal growth of the scallops. For a copy of this publication, send \$2 to UNC Sea Grant, Box 8605, Raleigh, North Carolina 27695-8605. Ask for publication UNC-SG-WP-83-6.

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## COASTWATCH

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# COASTWATCH

Photo by Mark Hooper



*A fisherman may work alone on the water, but back on the docks he's willing to share his ideas*

## Fishermen talking.

Over the VHF radio, on the telephone or down on the docks, they're exchanging information and sharing ideas with friends. They don't hesitate to tell a fishing friend about a new piece of gear that will catch him more fish. And before long, news of that new equipment has passed from

fisherman to fisherman. Everybody knows.

A Sea Grant researcher has studied how fishermen exchange information. This month, *Coastwatch* takes a look at the study, how its results will help Sea Grant's Marine Advisory Service and what some North Carolina fishermen are saying about how they exchange information.



# Who's a leader among fishermen?

In New England, they're called "highliners." Here, they're known as "smart" or as "experimenters."

They're the fishermen who are respected. The ones whose names always come up in conversations about commercial fishing. The ones who are first to try something new. They are the leaders.

Sea Grant researcher Jeff Johnson, an anthropologist at East Carolina University, recently completed a study of social networks, information flow and the adoption of technology among North Carolina commercial fishermen. He found that the relationships in a fishing community have a strong influence on the way fishermen do things.

If you ask North Carolina fishermen who their best friends are, they'll say they are friends with everybody in town, says Johnson. But, ask them whom they respect, to whom they talk and to whom they look for advice. Chances are, the names of a few fishermen will be repeated. Johnson says those fishermen are the leaders in the community. And, they hold the key to getting information circulated through the community.

Johnson's study is the first of its kind to concentrate on fishermen. Previously, studies focused on farmers. Those studies pointed to people who had higher incomes, had more education, and who read a lot as the leaders in the community. "But, fishermen are different from farmers," says Johnson. "Farmers may not see their neighbors for weeks. But fishermen pull into the same harbor every day. We need to know how information gets passed among those fishermen."

Johnson hypothesized that people do things because they talk to others and observe others. To test that hypothesis, he took his study to Crabtown, North Carolina. He won't divulge the real name of the town he studied, but he does provide a few clues. Crabtown is a rural village along the central North Carolina coast. For

the past two centuries, Crabtown's existence has depended on commercial fishing. Johnson says fishing is more than an occupation for the approximately 500 Crabtown residents; it's a lifestyle.

Johnson spent a summer with the fishermen of Crabtown. He talked with them, fished with them, and interviewed them. (Marcus Hepburn, another Sea Grant researcher, helped Johnson collect the data.) And, he found that the Crabtown fishermen were cliquish. By questioning the fishermen about their associations with other fishermen, Johnson was able to construct a model of social networks in the fishing village consisting of four cliques. "Once we know the structural relations in the community, we know how to get information out," says Johnson.

Crabtown fishermen consistently referred to two main cliques—the Big Fleet and the Little Fleet. The cliques

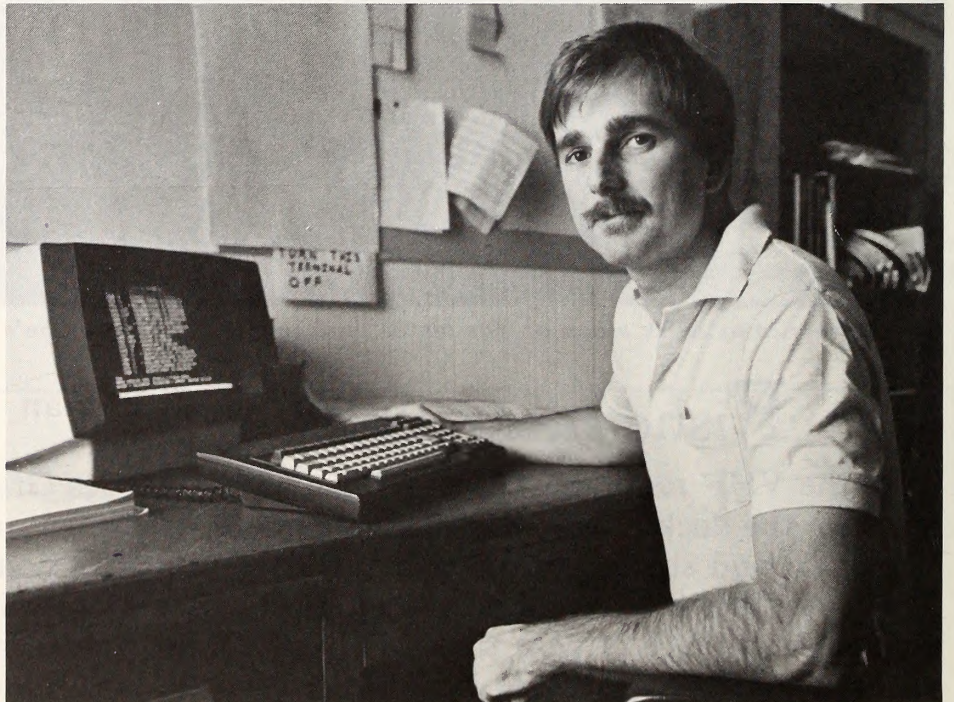
are based on the age and fishing style of its members and where they dock their boats. The Big Fleet is composed of fishermen in their late 30s. The Little Fleet is made up of fishermen in their late teens or early 20s.

Out of the four basic cliques, at least two fishermen emerged as "opinion leaders," says Johnson. One of those fishermen was referred to most often by other fishermen as someone they talked to frequently. The other leader is part of the Big Fleet, but he has connections with the younger group as well. These "cross-clique ties" allow him to serve as a liaison between the two groups, says Johnson.

"If I want to get information to the fishermen, I'd first want to know who are the opinion leaders," says Johnson. "Then I'd look for someone with cross-clique ties to maximize the possibility of getting the information to the fishermen."

For example, Johnson knew that he

*Photo from ECU News Bureau*



*Jeff Johnson works out network models on his computer*



**"If I want to get information to the fishermen, I'd first want to know who are the opinion leaders."—Jeff Johnson**

could expect a fisherman to follow the example set by his clique. If the leader of one clique adopted an innovation, the others would follow.

To test that theory, Johnson examined the adoption of two innovations: a sled for shrimp trawling (see page 5) and a kicker plate for clam kicking. The sled replaced the heavy wooden doors on the inside wings of a shrimp net. The kicker plate directs the prop wash from the boat down at the sediments, loosening clams and making them easier to net. The kicker plate has increased the efficiency of mechanized clamming and has allowed fishermen to exploit clam beds in areas not accessible with the use of traditional techniques.

Johnson found different results for each innovation. Most of the fishermen adopted the sled in the first two shrimping seasons. But, the kicker plate showed a longer period of adoption.

Opinion leaders aren't the only influencing factors in the adoption of an innovation, explains Johnson. For example, a fisherman is more likely to

adopt an innovation if he can see it in operation. One fishermen told Johnson, "You see somebody do something and you'll try it."

The sled is plainly visible to other fishermen, particularly when the boat is in the harbor. Johnson says it "would have most knowledgeable fishermen questioning its advantage and use."

On the other hand, the kicker plate is found on the rudder below the waterline. The only time a fisherman would see the plate is when the boat is in dry dock. Johnson says the kicker plate's low visibility contributed to its long adoption period.

Fishermen can also find out about innovations by listening to their VHF or CB radios. The first fisherman to experiment with the sled in eastern North Carolina heard the captain of a large shrimp boat say that it was the greatest rig he had ever used. Johnson says that captain played an important role in the adoption of the sled in the area.

The radio is so effective in spreading information that some fishermen

either keep it turned off or talk in elaborate codes that only members of their clique can decipher.

The opinion leaders have other ways of learning about innovations. "People who read commercial fishing periodicals tend to be more experimental," says Johnson.

But, he adds that education is not necessarily a determinant of an opinion leader. "For the older fishermen, a seventh-grade education in their day was pretty good. It's as good as a high school education is today," says Johnson. "But once a fishermen knows how to read and write, that's all that matters out on the water."

Johnson says his study has just begun to explain the flow of information through a fishing community. His next step would be to follow these fishermen for three or four years, monitoring the cliques for change and observing the adoption of other innovations.

He adds that it's time to know as much about fishermen and their social network as we know about farmers.

—Nancy Davis

*Photo by Steve Murray*



*At harbors such as this in Oriental, fishermen often share information with fishermen docked nearby*



# From a fisherman's view

**C**oastwatch went straight to the source—the fishermen—to find out how they exchanged information, to learn how they heard about new innovations, and to discover who were leaders and innovators in the fishing community.

For Clinton Willis, a Marshallberg fisherman, seeing is believing. And believing means trying it for yourself. Willis says once a fisherman sees a new piece of gear and hears that it works, then he's usually willing to try that piece of equipment for himself.

Willis says that sometimes other fishermen share their innovations and sometimes they won't. "I asked a fishermen about a boat he had rigged with a four-barrel trawl," Willis says. "He told me he had worked out the problems himself and I would have to do the same. I did work it out myself."



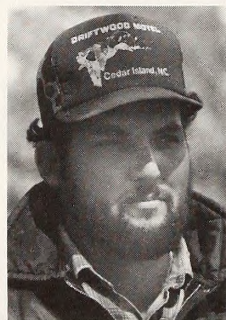
Benjamin Brooks, a Harkers Island fisherman, sees himself as an experimenter. "A lot of ideas I come up with are my own," Brooks says. "I work them out and try them myself. Right now, I am experimenting with a deep-water clamming boat."



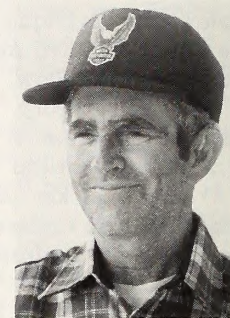
Brooks says some people in the community think he experiments too much. "But I'm not satisfied with things that always stay the same," he says. "I get bored. I like to try something different. I like to see improvements. I don't think I would make much of an assembly-line worker." But Brooks says he

doesn't mind sharing his new ideas.

Paul Nelson, a Williston fisherman, says he occasionally gets ideas about new gear and fishing techniques from commercial fishing publications such as *National Fisherman* and *The Small Boat Journal*. But more often than not, it's from friends and family that he learns about new innovations. "Most fishermen are outgoing with their new ideas," Nelson says. "I have a lot of respect for the older, 40- to 50-year-old fishermen, who have a lot of experience behind them, but are also still willing to experiment. The most successful fishermen are those that have knowledge and who are willing to work hard. What you get from the water you have to work for."



Earl Chadwick, a Marshallberg fisherman, has been plying the waters of Core and Back Sounds for 37 years. He was the first fisherman in Carteret County to try the four-net/sled configuration on his 26-foot trawler. "I heard about it (the four barrel) from some of my relatives who were fishing down south," he says. "I tried it. I made the doors and nets myself." Despite the fact that the twin nets did not work out on Chadwick's small boat, he is proud of being the first to experiment with the twin nets.



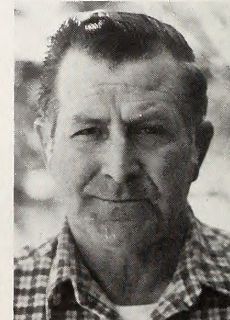
Chadwick says most fishermen learn about new gear from other fishermen. "Fishermen are like a bunch of ducks," he says. "One of them does something and all the others follow." Chadwick says that the younger fishermen in the area tend to look to the older, more experienced fishermen for help and advice.

Mark Hooper, a Smyrna fisherman, says most Carteret County fishermen are willing to share their new ideas and information about new gear with the fishermen they know. "Word usually spreads pretty fast, especially around bigger fish houses where a lot of fishermen dock," Hooper says. "If a fisherman finds a piece of gear or equipment that works a little better, he's usually willing to share it with those he works around. Fishermen get together and talk. They talk on the radio (VHF) or at the fish house. It amazes me how fast word can spread."



James Styron, a 53-year-old Davis fisherman, says there are no secrets in small fishing communities anymore. "In small areas like this, everybody knows about a new piece of gear in two days' time," Styron says. "Whether they find out over the radio (VHF) or through direct communication, everybody knows."

Styron says one innovation has swept through Carteret County this year. It's the steel cage. Fishermen have replaced the "bags" they pull behind their boats with steel cages. "They're more efficient," he says. "They last longer and the upkeep is less. And they catch less sand and seaweed." Styron estimates after only one (clam kicking) season, 70 to 80 percent of the fishermen in his area are using the steel cage.





# An innovation tailored To Carolina waters

One hundred years ago fishermen used row boats, sail boats and seines to net shrimp. Today, it's motorized, mechanized trawlers hauling large "two-barrel" or "four-barrel" nets.

Between the seine net and the double trawl are a lot of innovations. Some of those innovations, such as the double rig, were developed outside of the state. But other innovations have been tailored just for the bent of the North Carolina coast.

Take the sled for instance. It was developed in Georgia during the 1970s as part of the four barrel or twin trawl, a net configuration that allows a fisherman to pull a set of two nets from the port and starboard outriggers. The sled is an "L"-shaped piece of metal placed in the middle of each set of nets. It attaches at the top and bottom line of the wings of each net and helps to keep the nets open vertically.

News of the twin trawls reached Carteret County by the mid-1970s, and the larger boats that fished offshore began to make the changeover. Some of the small trawls (less than 40 feet) that shrimped "inside" or sound waters also experimented with the four barrel.

"I tried the four nets with the sled," says Earl Chadwick, a Marshallberg fisherman. "But I didn't have room on my 26-foot boat for all those nets, and my boat didn't have enough power to pull all that weight."

Other fishermen experienced similar problems, so the small-boat fishermen abandoned the idea of shrimping with the twin trawl. But the experimentation did introduce the idea of substituting the sled for one or more of the doors.

The doors are flat wooden structures that traditionally had been attached to

the wings of the net to spread it horizontally. But shrimping with the four-door, double trawl meant steering problems for fishermen plying the shallow waters of Core and Back Sounds.

In shallow water, the prop wash did not pass over the top of the two inside doors as it did in deep water. Instead, the prop wash was deflected straight back from the boat between the two inside doors. This presented no problem as long as the boat moved in a straight line. But in rough weather, the prop wash often began striking first one inside door and then the other, causing the trawlers to see-saw.

And even on calm days, shrimpers had problems steering their vessels during turns. The prop wash would strike the inside door on the opposite side from the turn, causing a great pull on the boat.

And while fishermen understood the cause of their problem, there seemed to be no solution in sight. No solution, that is, until they saw the sleds used on the twin trawls. Almost immediately, Carteret County fishermen began experimenting with the sled on their double-barrel trawls, says Jeff Johnson.

First the fishermen tried a pipe, filled in the bottom with lead, Johnson says. The pipe acted as a weighted staff that fishermen hoped would hold the nets open vertically. But the pipe did not prove successful.

In 1978, several "downeast" fishermen began experimenting with the "L"-shaped sled, Johnson says. But instead of using only one sled between two nets as was done in the twin trawl configuration, Carteret County fishermen used two sleds between two nets. They ran a line, known as a crossover line, between each sled. Using this configuration, the outside doors opened

Photo by Mark Hooper



*Metal sleds replaced inside wooden doors on shrimp trawlers*

the nets horizontally and the sled opened them vertically, Johnson says.

The sleds created little or no resistance to the prop wash and boat maneuverability was increased dramatically. "It gets the nets and the doors away from the wheel wake," says Paul Nelson, a Williston shrimper. "You can pull the nets a lot easier. It's easier to turn around and the boat is more steady while you're towing."

But the real test for the sled came when fishermen pulled in the nets. "I think the nets with the sleds produce as much shrimp as the nets with the doors, maybe a little better," says Nelson. Johnson says the two-door/two-sled configuration allowed the fisherman to fish a wider range of environments without steering problems.

Most of Carteret County's inside shrimpers began using the sled. "Several fishermen told me the sled saved the small boat," Johnson says. "The feeling was that the smaller class of shrimp boat (under forty feet) became much more competitive to the larger class of inside boat since the smaller boats could concentrate more on shallow-water trawling and had more efficient gear."

—Kathy Hart



# The science of providing advice

Sea Grant's marine advisory agents know that research is no good if it stays in the laboratory. So, they peddle information and innovations out on the docks, in seafood houses and on the beach.

The agents spend some time behind their desks, answering questions and offering advice. But, part of the time, they're out trying to spread the word about new ways to catch fish, to shed crabs, to fiberglass a boat. And, they've learned the value of knowing just who to turn to in a community where they're trying to get the word out. They've also learned that it's sometimes hard to find the leaders in a fishing community.

Jim Murray, Sea Grant's Marine Advisory Service director, says Jeff Johnson's study of social networks, information flow and the adoption of technology among North Carolina commercial fishermen, will help his team improve the way they do business.

"Johnson approached his study in a very scientific way," says Murray. "But our agents can use the study to pinpoint the leaders for themselves. They can make themselves available, ask questions, and find out who the highliner is in a community. With a little digging, they can find him."

Murray says the best way to find an opinion leader is by asking around. "You say, 'I've got this idea. Who is the best person to talk to about it.' And, pretty soon, you start hearing one name repeated by most of the fishermen."

"Once you find him, you start dealing with him on a personal basis. You cultivate that relationship," says Murray.

Photo by Steve Wilson



Jim Murray

Johnson's study is more than an assessment of the social networks in Crabtown, North Carolina, says Murray. There are approximately 400 Sea Grant marine advisory agents nationwide. With the help of this study, they'll all be able to do their jobs better, says Murray.

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, NCSU, Box 8605, Raleigh, N.C. 27695-8605.

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| <input type="checkbox"/> City/County government | <input type="checkbox"/> Marine recreation               |
| <input type="checkbox"/> Commercial fishing     | <input type="checkbox"/> Mass media                      |
| <input type="checkbox"/> Educator               | <input type="checkbox"/> Seafood processing/marketing    |
| <input type="checkbox"/> Farming                | <input type="checkbox"/> State government                |
| <input type="checkbox"/> Homemaker              | <input type="checkbox"/> University professor/researcher |
| <input type="checkbox"/> Lawyer                 | <input type="checkbox"/> Other _____                     |

Coastal property owner ☐ yes ☐ no Boat owner ☐ yes ☐ no



# THE BACK PAGE

"The Back Page" is an update on Sea Grant activities — on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454). For copies of publications, write UNC Sea Grant, NCSU, Box 8605, Raleigh, N.C. 27695-8605.



If you'd like to learn how to raise striped bass fingerlings, UNC Sea Grant has a workshop for you. Sea Grant and the N.C. Cooperative Fishery Research Unit are sponsoring a three-day workshop, May 7-9, at the Aquaculture Research and Demonstration Center in Aurora. Randy Rouse, UNC Sea Grant's aquaculture agent, says the workshop will be a "hands on" opportunity for participants to learn how to spawn striped bass females and fertilize the eggs with white bass or white perch sperm. The workshop will also cover the techniques used to raise the hybrids from the egg to the fingerling size.

Howard Kerby, a Sea Grant researcher who has worked extensively with striped bass hybrids, will provide most of the workshop instruction. But members of the N.C. Division of Marine Fisheries and the N.C. Wildlife Resources Commission will be on hand to explain the laws that pertain to obtaining the stocks.

The cost of the workshop will be \$40 if participants choose to stay in a dorm or trailer at the Aquaculture Research and Demonstration Center (bring your own sleeping bag). The cost is \$30 if participants choose to find their own accommodations. The registration fee includes a striped bass culture book and four meals (two breakfasts, two lunches).

The workshop is limited to 20 par-

ticipants, who will be chosen on a first-come, first-serve basis. To register, send the registration fee to Ron Hodson, UNC Sea Grant, NCSU, Box 8605, Raleigh, N.C. 27695-8605. For more information, call Hodson at 919/737-2454, or Rouse at 919/322-4054.



**Year of the Ocean.** It's a celebration King Neptune would smile on. From March 10, 1984, until March 10, 1985, events are planned that will educate the public about the ocean's heritage, its resources and its future. In North Carolina, October 6-14, has been designated as Week of the Ocean. Museums and schools are planning special "ocean" events.

Doug Young at the Office of Marine Affairs in Raleigh is keeping a calendar of events for this year-long celebration. If you'd like to find out what's on the schedule or would like to place an event on the calendar, contact Young at the N.C. Office of Marine Affairs, 116 W. Jones St., Raleigh, N.C. 27611. Or call 919/733-2290.



Fish may be flocking to piers if an artificial reef proves successful. Jim Murray, director of Sea Grant's Marine Advisory Service, and David Lindquist, associate professor of biology at the University of North Carolina at Wilmington, are testing fish aggregating devices, or floating reefs, in the waters off of piers at Wrightsville Beach.

Murray says the devices will be placed alternately off two piers, with one pier serving as a control. They'll move the devices back and forth between the piers to avoid having people fishing off just one pier.

The aggregating devices, which will be placed about 250 yards from the

end of the piers, are made of fiberglass rods with netting which hangs in the water. The devices are secured 10 to 12 feet off the ocean floor by vertical float lines.

Last fall, the researchers gathered catch per unit of effort data for each pier. Once they install the devices, Murray and Linquist hope to be able to tell if the fish populations increase at the pier with the devices and if the devices actually improve fishing at the pier.

We'll let you know the results of their study.



**Kudos to Coastwatch.** For the third consecutive year, *Coastwatch* has won an international award from the Society for Technical Communication (STC). After the judging was over, *Coastwatch* garnered an Award of Achievement at the 1983-1984 International Technical Publication Competition. *Coastwatch* was edited by Neil Caudle; Kathy Hart and Nancy Davis were staff writers.

Two other UNC Sea Grant publications—*Sea Grant in North Carolina, 1981-82* and *About Hurricanes*—earned Awards of Merit at the regional competition sponsored by the Carolina Chapter of the STC. *Sea Grant in North Carolina, 1981-1982* was written by Neil Caudle, Kathy Hart and Nancy Davis. *About Hurricanes* was a publication produced by UNC Sea Grant, the N.C. Office of Coastal Management and N.C. Division of Emergency Management.

Kathy Hart is Sea Grant's new Director of Communications. Hart, a graduate of the UNC School of Journalism, has been with Sea Grant for five years. As Director of Communications, she will also serve as editor of *Coastwatch*.

*Continued on next page*





Get out your camera. It's time to start shooting for the Bogue Banks Photography Competition. North Carolina photographers can enter their best color

and black-and-white prints depicting the beauty of the North Carolina coast—including plants, animals and natural scenes. In a new category, photos may depict any aspect of life in coastal North Carolina.

The competition is sponsored by the Marine Resources Center at Bogue Banks, the Carteret County Arts Council, Branch Banking and Trust Company, and the N.C. Marine Education and Resources Foundation.

Entries will be accepted June 1-3 at the Marine Resources Center at Bogue Banks. Complete rules are available by writing Marine Resources Center/Bogue Banks, Atlantic Beach, N.C. 28512, or by calling 919/247-4004.



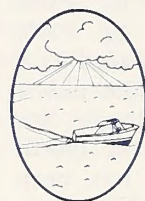
They've been popular in Europe for years. Now, they're catching on in America. What is this European invasion? It's the bed and breakfast home. More

Americans are making a profit on unused rooms by turning their homes into bed and breakfast lodging. But, Rich Novak, Sea Grant's recreation specialist in Manteo, says there are some things to consider before opening your home to strangers. That's why he

has written a booklet, *Opening a Bed and Breakfast*.

The booklet describes the investments, regulations, reservation and scheduling system, and rate structure a prospective bed and breakfast owner should consider before making his or her home a bed and breakfast business. For a copy of *Opening a Bed and Breakfast*, write UNC Sea Grant. Ask for UNC-SG-84-03. The cost is \$1.

Leon Abbas, UNC Sea Grant's coastal recreational specialist and marine economist, has resigned. Abbas, who has been with the program since August 1977, is leaving to enter private business. His resignation is effective June 30.



The North Carolina coast offers some of the best saltwater fishing between Maine and Florida. The nearby Gulf Stream attracts a wide variety of fish to

challenge the angler. Many people who don't own seaworthy vessels participate in offshore fishing by taking a day trip on a charter boat or headboat. A charter boat is a vessel that is rented by groups of up to six people. Headboats, which are larger vessels, can often accommodate up to 125 people. Generally, reservations are required for charter boats and may also be necessary for headboats.

To help anglers locate a charter boat or headboat for their fishing expedi-

tions, UNC Sea Grant, the National Marine Fisheries Service and the N.C. Division of Travel and Tourism have put together a list of most of the charter boats and headboats operating along the North Carolina coast. The listing provides the name of the boat, the captain, the docking location and a telephone number for making reservations.

For a copy of this free brochure, write UNC Sea Grant. Ask for "A Listing of Charter Boats and Headboats in North Carolina."

If you're a property owner along a North Carolina river or sound, you may have some rights you didn't know about. They're called riparian rights. Walter Clark, Sea Grant's coastal law specialist, says that one of the most recognized riparian rights is the right of access to deep water. Clark has written a blueprint, *Riparian Rights: What Are They? What Are Their Limits?* If you'd like a free copy of the publication, write UNC Sea Grant. Ask for UNC-SG-BP-84-1.

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## COASTWATCH

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# COAST WATCH

Photo by J. Foster Scott



*A pinpoint landing makes two laughing gulls on a piling*

## The birds

Plume hunters plundered their colonies during the late 1800s. Then people began crowding them out of their natural nesting habitats—the swamps and beaches. A few years ago, the pesticide, DDT, took its toll on some species.

But so far, they've survived. Generally, they're referred to as colonial waterbirds. But specifically, they're egrets, ibises, herons, gulls, skimmers, terns and pelicans. They nest in colonies—hence the name colonial—along North Carolina beaches and estuarine islands during spring and summer.

Colonial waterbirds have been subdivided into colonial seabirds (pelicans, gulls, terns and skimmers) and colonial wading birds (herons, egrets and ibises). The seabirds that nest in North Carolina are migratory and for the most part, lay their eggs in simple nests on the ground. Wading birds tend to nest in dense thickets of shrubs and low trees. Some wading birds overwinter in the state.

For over a decade, North Carolina's colonial waterbirds have been under the scrutiny of James Parnell, an ornithologist at the University of North Carolina at Wilmington and a UNC Sea Grant researcher. Parnell has examined the birds' nesting habits and habitats, and counted their populations.

Ask Parnell why colonial waterbirds need to be studied and protected, and he will gruffly answer, "On good days, I tell people that colonial waterbirds

*Continued on next page*



are at the top of the food chain. They're important environmental barometers which indicate the health of the ecosystem. They're also an important part of the ecosystem and we don't know what would happen if they weren't there. For all we know, they could be important links in the transfer of energy from the ocean to the estuary.

"On bad days, I tell people that the birds have as much right to be there as any other bird, animal or human. They're pretty, and people want to see them and enjoy them."

For years the government and private organizations have worked to manage the populations and habitats of game birds such as ducks, geese and doves. But until recently, the idea of managing non-game birds usually meant only protecting them, says Parnell.

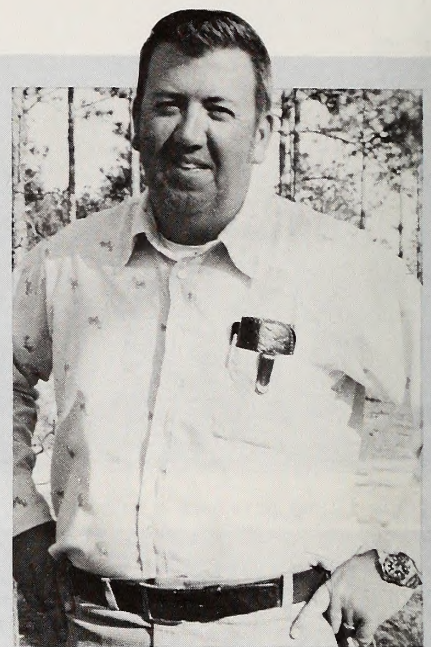
Under the Migratory Bird Treaties, it is illegal to kill waterbirds. The National Audubon Society, which was conceived in part to stop the carnage of waterbirds to feather women's hats, has worked since 1904 to protect nesting areas through its sanctuary program (see story, page 4). And all colonial-waterbird nesting sites on wildlife refuges or at national parks are protected.

Since the 1920s and 1930s, the U.S. Army Corps of Engineers has managed colonial-waterbird habitats incidentally to its management of the Intracoastal Waterway and other

navigational channels. The sand, silt and shell dug from these channels resulted in the creation of over 400 man-made islands in the state's estuaries.

The dredge-spoil islands were ideal nesting areas for colonial waterbirds. And they were built at a time when the birds were beginning to come up short on natural nesting habitats because of increased beach utilization and development of the barrier islands.

The continued maintenance of the waterway and channels through dredging has also meant continued upkeep of waterbird nesting habitats. The corps occasionally deposits a new



"I tell people that colonial waterbirds are at the top of the food chain. They're important environmental barometers which indicate the health of the ecosystem."

—James Parnell

covering of dredge material on some of its man-made islands, leaving behind a bare site. Such sites will revegetate, passing through a series of predictable stages of succession, each of which may provide nesting habitats for different species of colonial waterbirds.

But modern environmental protection laws now require the corps to dike any upland deposition of dredge material. Parnell says diked islands tend to sag, forming hollows for the collection of fresh water, which speeds the growth of vegetation on the island. And for those species of waterbirds, such as terns and skimmers, which

Photo by J. Foster Scott



*Heedless to the warnings of man, these gulls make themselves at home on a private dock*





*Sandwich terns are distinguishable by their bicolored bills*

prefer sandy nesting habitats, the islands quickly become useless.

Parnell says there could be problems in the future for the sandy nesters if too many diked, dredged islands became heavily vegetated or if the corps continues to deposit more and more of its dredge material on beachfront or mainland areas. A 1983 census of all nesting colonial waterbirds in North Carolina, conducted by Parnell, showed a decline in the populations of least terns, common terns, gull-billed terns and black skimmers—all bare-sand nesters.

Parnell points out that new deposits of dredge material or other manage-

ment tools such as tilling, applying plant retardants or burning could be used to keep vegetation at a minimum. Scientists are just beginning to study methods of altering or creating nesting habitats for colonial waterbirds.

In the 1983 census, sponsored by IUNC Sea Grant and U.S. Army Corps of Engineers, Parnell found that four percent of the colonial-waterbird nests occurred on barrier-island sites; 18 percent on natural estuarine islands; 27 percent on diked, dredge-material islands; and 51 percent on undiked, dredge-material islands. He also learned that populations of brown

pelicans, white ibises, laughing gulls and royal terns had increased since his 1977 census.

After comparing the 1977 and 1983 censuses, Parnell found that the waterbirds were nesting at fewer sites, but that the sites in use were supporting larger colonies. This trend has Parnell worried because dense aggregations of birds at relatively few breeding sites might mean a single catastrophic event, such as an epidemic, could spell disaster for a large percentage of birds.

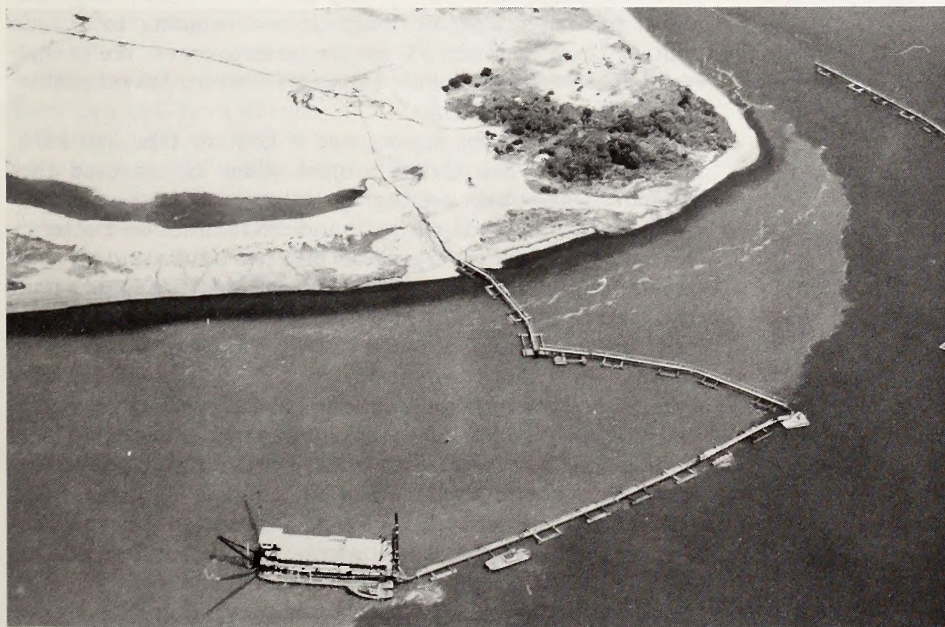
But it's not only habitat degradation that has ornithologists worried about the waterbirds' future. Scientists are also concerned about the encroachment of man.

"There's a recognition on the part of Audubon that the human population in this country is shifting to the southeast," says Donald McCrimmon, a research biologist with the National Audubon Society. "That's potentially a problem for colonially nesting waterbirds."

"In North Carolina, the greatest threat is from recreational interests that are only going to increase with more and more people using the waterways. More birds are going to be subject to impact. We need to learn more about the resource requirements of birds to permit them to coexist with the surge of populations."

Parnell says human disturbance of colonies during nesting may leave the eggs or newly born chicks vulnerable to weather conditions or predation from other birds and animals. During spring and early summer, he warns people to avoid the islands where the birds are nesting and to leave the nests and young chicks of beach nesters alone.

—Kathy Hart



*Fresh dredge material being deposited on an island*



*Baby common tern and egg*



## Battery Island

# A home for all birds

Each year, beginning in April, about 10,000 feathery travelers arrive at Battery Island—a chunk of marsh rising out of the Cape Fear River, just across from Southport in Brunswick County. The birds build simple stick platform nests in a dense thicket of red cedar, yaupon, wax myrtle and live oak. Throughout the summer they nest and raise their young. When autumn arrives, most of the birds fly away to parts unknown.

Battery Island is a popular summer home for birds. Its population includes representatives of almost all the heron, egret and ibis species found in North Carolina, and the island is home to the state's largest population of white ibises. So far, the birds have been returning each year in equal or greater numbers than the year before.

In 1982 the state and the National Audubon Society agreed to a partnership. The state would lease Battery Island to Audubon as a sanctuary which would be managed through the University of North Carolina at Wilmington

(UNC-W). James Parnell and his graduate students would oversee the project. (The state originally acquired Battery Island in 1978 as part of a greater tract of land donated by the N.C. Nature Conservancy.)

State officials say it's a novel approach to maintaining a site just for birds. "It's the first time that the state of North Carolina has entered into an agreement like this," says Tom Wells, a consultant and management planner for the state's Division of Parks and Recreation. "It's a joint venture management plan, primarily for the benefit of the birds."

Parnell and Audubon officials are quick to point out that Battery Island is more than the usual bird sanctuary, where protection is the primary goal. "Audubon wants to do that here. But in addition, this sanctuary is the site for some management research as well as a place to protect the birds," says Parnell.

The Audubon Society wants to learn how to manage wading bird colonies, says Donald McCrimmon, a research biologist with the National Audubon Society. Not an easy task with herons, egrets and ibises, he adds.

Parnell explains: "The birds, in the process of nesting and raising their young, actually damage their own habitat. They produce so much excrement that they overfertilize the vegetation."

The result is a die-back of the vegetation in which the birds nest. (While seabirds nest on the ground, wading birds prefer thickets of bushes and trees.) Consequently, the island is no longer as desirable a nesting ground, says Parnell. "As long as there are plenty of places to nest, they just move on," says Parnell. "But, if you're going to try to manage them, you don't want the birds to leave. We're trying to learn how to make a place like Battery Island usable for a long period of time."

Parnell learned the importance of Battery Island in 1976 and 1977 in a Sea Grant project when he censused the colonial waterbird nesting populations of the North Carolina estuaries. Then, he found 1,831 nests on Battery. (Parnell says one nest translates into two adults and at least one young bird.) In his report, Parnell said the colony had been stable for the past four years, the thickets where the nesting took place appeared healthy, and there appeared to be room for colony expansion.

But since then, the populations have grown to over 5,000 nests. While bird lovers rejoice the expansion in the colony, Parnell and the Audubon Society want to make sure the island can remain a viable nesting ground.

Parnell says the work on Battery Island will be a long-term project. He and his students will be looking at the birds' reproductive biology, nest-site characteristics and population dynamics. They'll be planting vegetation to see what can best withstand the heavy doses of nitrogen in the



*Tricolored heron perches in a thicket*





birds' excrement. They'll be tilling small plots of vegetation to see the effects. And, they may even attempt to create "artificial" bushes for the birds to use while destroyed vegetation grows back.

The biologists will be manipulating the habitat in the hope of producing a more stable, long-term environment for the birds, says McCrimmon.

The management possibilities include maintaining the habitat for herons and egrets as well as developing a habitat for ground-nesting birds such as least terns, brown pelicans and laughing gulls, says McCrimmon. That may mean planting hardier vegetation for the herons and egrets, or changing the substrate in a way that will attract the ground nesters.

"We'd like to make Battery a place where a variety of birds could find a safe place to nest for a long period of time," says McCrimmon. "There's a tendency for colonies like this to come and go. The real challenge is to make the colony suitable for 25 years or more."

For example, terns and gulls may nest for only two to five years on an island before its vegetation changes and they move on to another island. But some wading birds will use the same island for as long as 25 years.

Not all the birds on Battery live in harmony and McCrimmon says they may eventually choose to exclude some species from nesting. For example, fish crows nest among the herons and eat about half of the eggs which the white ibises lay. Mark Shields, one of Parnell's graduate students and the Audubon warden on Battery Island, found that fish crows are able to get the ibis eggs, regardless of the density of the vegetation where the birds nest.

The crows are greedy; they take many more eggs than they can eat, says Shields.

Parnell says the fish crows are one pressure on the birds they may decide to eliminate. For example, they might try to manipulate the vegetation in such a way as to reduce the crow population by making the site less desirable to that species.

If fish crows don't get the eggs, the birds face possible predation from the black-crowned night heron. Those birds go after the young of the other species and feed the baby birds to their own.

Such predators get help from cattle egrets which arrive at Battery Island later in the season, when the other species have already begun to nest. They disrupt the nesting birds, leaving the young vulnerable to predation.

About two weeks after the young birds hatch from the egg, they venture from the nest. This is when they are most vulnerable to people. As a sanctuary, Battery Island is off-limits to visitors and, as warden, Shields has the authority

to enforce that rule. It is particularly crucial to avoid human intrusion during the nesting weeks, says Parnell.

The birds may also find themselves at the mercy of the weather, says Parnell. "Timing is critical. A storm can be very damaging to young birds. All the nests may be destroyed or the birds may be beat to death by hail."

McCrimmon points out that, to some extent, the hazards which face the birds—predation from other species, over-fertilization of the vegetation, and exposure to bad weather—are all part of a natural system of checks and balances in the population. But the Audubon Society hopes to help the birds maintain a balance on Battery Island. If they succeed, the birds will return. If nature takes her course, the birds may destroy their own home and go in search of another.

—Nancy Davis



*White ibis hatchling peers from its nest*



*Adult white ibis, a wading bird*



# Brown pelican colonies flourish

There's something about a pelican that draws attention in North Carolina. Maybe it's their comical appearance—that curved neck, bald head, long beak and drooping pouch. Or maybe it's because we're not accustomed to seeing the birds, whose populations have never been strong in this state. Well, until now that is.

In the early 1970s, birdwatchers, ornithologists and federal officials were worried that our feathered friend might not survive the perils of modern society. The pesticide DDT caused pelicans to lay eggs with thin shells that frequently resulted in the death of its contents. In response to its problems and dwindling populations, the eastern brown pelican was placed on the U.S. Fish and Wildlife Service's Endangered Species list in 1973.

The pelican's nesting sites were protected from North Carolina to Florida. And to help matters, DDT was banned in 1972. The pelicans began to slowly recover.

In his 1977 survey of nesting colonial waterbirds, James Parnell found 100 pairs of nesting brown pelicans in North Carolina's estuaries. In his 1983 survey, approximately 1,300 pairs were located. "We don't claim all these are new birds," Parnell says. "Some may have relocated from a South Carolina site that washed away."

In his book, *Atlas of Colonial Waterbirds of North Carolina Estuaries*, (available for \$7 from UNC Sea Grant), Parnell says that brown pelicans have been nesting in North Carolina since 1929. For over 25 years, the only known colony of pelicans nested on small islands near Ocracoke.

But in 1978, a new colony was established on two neighboring dredge-spoil islands, Old Royal Tern Island and Ferry Slip Island, in the Cape Fear River. Along with the terns, laughing gulls, oyster catchers and black skimmers, the pelicans nested on the islands in the spring and summer. In just a few years, the Cape Fear site became the largest nesting colony of pelicans in the state.

But in 1982, erosion threatened the pelican's Cape Fear nesting haven. Parnell and others were worried that the nests would wash away during



*Fluffy, young brown pelicans*

spring and summer storms. And to make matters worse, there were no other islands in the area suitable for the pelicans to move to.

The U.S. Army Corps of Engineers recognized the need to save the pelicans' nesting site. They appealed to the N.C. Office of Coastal Management to bend their water quality standards so that the island could be rebuilt. The state agreed that the pelicans were a case worthy of a little rule-bending.

Early last year the corps dumped 30,000 cubic yards of dredge material on Old Royal Tern Island, enlarging it from 1.5 acres to 4 acres and raising its elevation from 1 foot above average high tide to 6 feet. The corps will take similar action with Ferry Slip Island in a few years.

While federal and state agencies worked to save the Cape Fear pelican colony, the birds were busy establishing another colony on an island near Atlantic. And last summer, a few nests were found on an island near Oregon Inlet.

All of this surge in population has led the U.S. Fish and Wildlife Service to propose removing the brown pelican

from its endangered list along the East Coast. "We have very good information that the populations of pelicans never really declined in Florida," says Judy Jacobs, a Fish and Wildlife endangered-species biologist. "The populations in South Carolina that were affected by DDT are back up to historical levels. And in North Carolina, populations are higher than ever before."

But Parnell is concerned about the possibility of removing the pelicans from the endangered list. "We know the birds are doing well now," Parnell says, "But we don't know why. I'd like to know why the birds are doing so well before we remove them from the endangered list because when that happens they lose a lot of support in the law."

The Fish and Wildlife Service will issue a final report on the status of the brown pelican this November. If the pelican is removed from the endangered list, it will become a "species of management concern," Jacobs says. This designation means the Fish and Wildlife Service will continue to allot funds and time to their management.

—Kathy Hart



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities — on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454). For copies of publications, write UNC Sea Grant, Box 8605, NCSU, Raleigh, N.C. 27695-8605.*



Five students from Elizabeth City State University have been awarded National Marine Fisheries Service summer stipends for study in the marine sciences. The students will spend eight weeks in Beaufort and Morehead City, with their time divided between the National Marine Fisheries Service Laboratory and the UNC Institute of Marine Science in Morehead City. They'll be attending classes as well as assisting scientists with their fisheries and estuarine research. Sea Grant Director B.J. Copeland says the program is part of an effort to increase the marine and coastal curriculum at Elizabeth City State University.

The five students are: Pretlo Knight, Tyrone Speight, Anna Joyce Digiovanni, Timothy McLendon and Gregory Robertson.

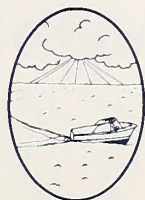
The summer stipends are just one way that Elizabeth City State University hopes to increase its marine science program. In February and March, the university presented a Marine Seminar Series for faculty, students and local school teachers. Dirk Frankenberg, Director of Marine Sciences at the University of North Carolina at Chapel Hill, provided an introduction to marine science. William Cleary, a professor at the University of North Carolina at Wilmington, presented a seminar on

coastal geology. Sea Grant Director B.J. Copeland gave an overview of marine environmental problems in North Carolina and Sea Grant researchers Stan Riggs, Hans Paerl and Charles Peterson summarized some of their research. Lundie Spence, Sea Grant's education specialist, gave a workshop on marine-science teaching resources.

UNC Sea Grant Director B.J. Copeland is chairman of an N.C. Marine Science Council committee on marine biotechnology. The committee will address the ways that North Carolina might become involved in marine biotechnology. "Marine biotechnology is near the verge of a major breakthrough and North Carolina is uniquely situated to be a leader in this future," says Copeland. Genetic engineering of fish and shellfish and the production of marine pharmaceuticals are just two of the many possibilities for marine biotechnology, he says.

Other members of the committee are: Bill Queen, Director of the Institute for Coastal and Marine Resources at East Carolina University; Ted Rice, Director of the National Marine Fisheries Service - Beaufort Laboratory; and, John Bone, executive vice president of the Outer Banks Chamber of Commerce.

The committee will report to the council at its meeting in Manteo, May 24 and 25.



More and more folks are choosing to live on the water. And with the growing number of floating homes or house boats, local governments have become concerned about the environmental, safety and health risks that may be associated with floating-home development.

Walter Clark, Sea Grant's coastal law specialist, says the 1983 session of

the N.C. General Assembly amended one of its statutes to give counties more control over development in state-owned waters within the counties' jurisdiction.

New Hanover County recently adopted an ordinance which places some regulations on floating homes in that county. Clark says court decisions in other states have generally upheld local ordinances which regulate floating homes so long as the ordinance is meant to protect the public's health, safety and general welfare.

If you'd like more information about the requirements for house boats, contact Clark at the Sea Grant office in Raleigh.



It's been 30 years since Hurricane Hazel thrashed the coast of North Carolina. Could this be the year when another major hurricane strikes? The state's Division of Emergency Management wants to make sure you're prepared. Hurricane Awareness Week will be held June 3-9. And, it will be a time for you to learn about hurricanes, what they can do and how you can be prepared.

Al Hinn, meteorologist-in-charge at the National Weather Service in Wilmington, says the next hurricane which strikes the coast has the potential to cause even more damage than Hurricane Hazel. "In the years since the 50s, we've seen a lot of development and growth take place on the barrier islands, and the day of reckoning will come. I think we'll pay a much dearer price when that time comes because we have much, much more to lose now than we did back then."

Hinn says that from a statistical point of view, North Carolina is hurricane-prone. "Hurricanes have not gone out of style," he adds. We've just been lucky lately.

For more information on hurricanes,

*Continued on next page*



write Sea Grant for the free publication, *Storms, People and Property*. Ask for UNC-SG-78-15. For tips on how to prepare for a hurricane, Sea Grant has a free blueprint, *Hurricane Safety Checklist*. Ask for UNC-SG-BP-82-3.

Frank Thomas, Director of Sea Grant's Seafood Lab in Morehead City, and Joyce Taylor, Sea Grant's marine advisory agent at the lab, have revised and updated *An Annotated Bibliography on Mechanically Separated Finfish and Crustacea Meats*. The new version contains more than five times the number of entries as the original publication. The revision, sponsored by Sea Grant, the Alaska Fisheries Foundation and the N.C. Agricultural Extension Service, provides an up-to-date listing of the literature available on mechanically deboned finfish and crustacea meats, as well as surimi. For a copy of the book, write Sea Grant and ask for UNC-SG-84-02. The cost is \$4.

Jim Easley, UNC Sea Grant's marine economics specialist, and Sea Grant advisory economists from other states have formed a committee on financial management for commercial fishermen. The economists will be assembling a resource manual describing various financial programs which commercial fishermen can use in their decision-making.



UNC Sea Grant has been providing its technical expertise at a series of public meetings on water quality. In March, the commissioners of Dare, Tyrrell, Hyde, Washington, Beaufort, Pamlico and Carteret counties held a workshop on water quality issues of the Pamlico peninsula. Sea Grant and the N.C. Agricultural Extension Service provided the technical assistance for the workshop. Sea Grant researcher Wayne Skaggs presented some facts on land drainage and Director B.J. Copeland responded with some answers from Sea Grant research. Wayne Wescott, Sea Grant's marine advisory agent in Manteo, presented the concerns of the fishermen.

In April, Sea Grant researchers participated in a seminar on coastal water management issues sponsored by the N.C. Department of Natural Resources and Community Development. Copeland gave an overview of estuaries and some of the complex problems facing the state's coastal water systems. And several Sea Grant researchers provided an update of university research.

Wayne Wescott, Sea Grant's marine advisory agent in Manteo, will present a series of workshops in June and July on recreational shrimping. The sessions will cover all the basics of what it takes to catch your own meal

of shrimp. For a schedule of the workshops, call Wescott at 919/473-3937.

Wescott also has written a Blueprint, *Recreational Shrimping: Nets, Doors and Power*, which provides some tips for rigging a boat for shrimping. For a free copy, write Sea Grant. Ask for UNC-SG-83-2.

Joyce Taylor, Sea Grant's marine advisory agent at the NCSU Seafood Laboratory in Morehead City, has prepared a colorful 17-by-22-inch poster depicting the seasonal availability of North Carolina seafoods. The chart is based on North Carolina commercial landing statistics from recent years and is intended as a guide for buying fresh fish and shellfish. For a single free copy of the poster, write UNC Sea Grant. Ask for UNC-SG-84-04.

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# COASTWATCH

JUL 7 1984



*A Theodor de Bry drawing of a John White map*

## For 400 years, we've wondered,

speculated and fantasized about the fate of Sir Walter Raleigh's Lost Colony. What happened to the people John White left behind? Historians and archaeologists have searched for clues. And still the answers elude us.

Some people have filled in the gaps with fictionalized accounts of the colonists' fate. But experts take little stock in the legend of Virginia

Dare growing up to become an Indian princess. Or, the one about the Lumbee Indians being descendants of the colonists.

Only a few people even know that Raleigh sponsored two previous expeditions to Roanoke Island. Or that those expeditions paved the way for the colonies at Jamestown and Plymouth.

This year, North Carolina begins a three-year celebration of Raleigh's voyages and of the people who attempted to settle here.

*Coastwatch* looks at the history of the Raleigh expeditions and the statewide efforts to commemorate America's beginnings.



# In celebration of the beginning

In July, the tiny town of Manteo will undergo a transformation. In the middle of its already crowded tourist season, it will play host for America's 400th Anniversary. Town officials can't even estimate how many thousands of people will crowd the narrow streets. But, they say, it's going to be a big celebration.

From now until 1987, North Carolina is celebrating the beginning of English America. The three-year commemoration marks the 400 years since the Roanoke voyages sponsored by Sir Walter Raleigh. The party begins on the 400th anniversary of the first expedition and ends on August 18, 1987, with the 400th anniversary of Virginia Dare's birth-day.

It's a celebration that's been at least ten years in planning. In 1973 the N.C. General Assembly created America's Four Hundredth Anniversary Committee. John Neville, executive director of the committee, says the group began preparing for the commemoration in 1978. Now, six years later, the celebration reaches beyond Dare County.

Across the country, advertisements have touted the upcoming events in *Better Homes and Gardens*, *The Smithsonian*, *Natural History* and *Southern Living*. Newspapers from as far away as Alaska, California and Great Britain have published articles featuring the 400th.

A television mini-series is being produced, a commemorative stamp will be issued, and more historical writings will be published.

On a smaller scale, plans call for each North Carolina county to hold local events to honor the nation's English roots.

The scope of the celebration has required coordination between state, county and local 400th committees, as well as coordination of events scheduled in England. The state-sponsored events actually began in April with the dedication of a plaque at Plymouth, England, to commemorate the first expedition's departure.

The official opening of the commemorative period is July 13-15 with the festivities taking place in Manteo.

Plans for the three-day weekend include the dedication and opening of the *Elizabeth II* Visitor Center, the commissioning of the ship, an Elizabethan fair, and the largest silent fireworks display in history. (The fireworks will be "silenced" to avoid interfering with "The Lost Colony" outdoor drama.)

State, national and international dignitaries will be on hand for the festivities. Princess Anne of Great Britain is scheduled to join Governor James B. Hunt Jr. on Friday, July 13, to officially open the celebration. On Saturday, Walter Cronkite will lead a flotilla of boats into the Manteo harbor.

And will President Reagan make an appearance at the nation's birthplace? Well, we'll know by July 13.

With that guest list, it's no wonder the town of Manteo wanted to spruce up its look. Five years ago, Manteo's

Board of Commissioners made a commitment to ready the town for the anniversary celebration, says Mayor John Wilson. Then, the town's waterfront was in a state of disrepair. By contrast, at the turn of the century more than 100 shops and businesses operated in the downtown area. The 400th provided the impetus to return that "healthy mercantile bustle" to the town, says Wilson.

In 1982, the Manteo commissioners adopted a \$10 million plan to redevelop the waterfront. After an 18-month search, the town found a developer willing to take the risk.

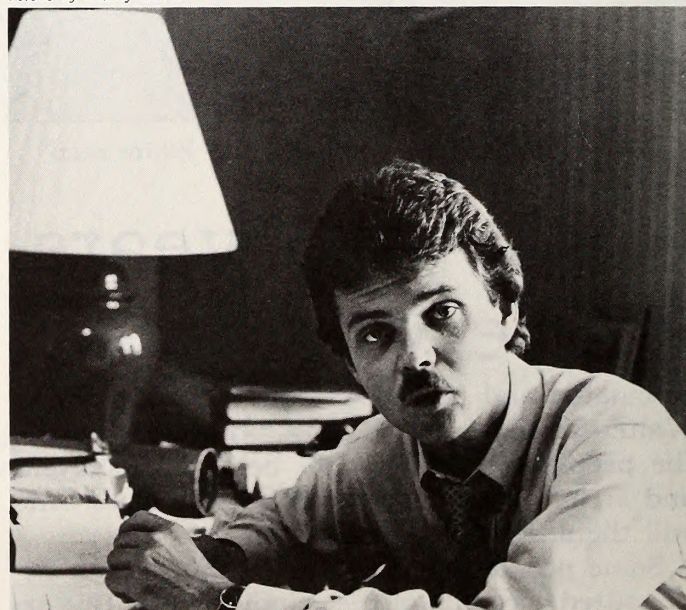
Not all the townspeople supported the redevelopment. "I think the idea that the town would change this dramatically in such a short period of time was a source of fear," says Wilson.

The plan called for three major redevelopment sites. To date, only one of those is under construction and should be completed sometime this summer. The site mixes residential and retail units, including a restaurant overlooking the water, sandwich shops, a bookstore, a candy store, and an English antique and gift shop. Above the shops will be 36 condominium units.

Wilson says the shops will remain open year-round because Manteo is a year-round residential community.

Dare County also is doing its part to prepare for the festivities. Herbert "Hubby" Bliven, chairman of the Dare County 400th Advisory Committee, says the three-day event has meant coordinating police, medical, sanitation and traffic crews. But Bliven says that all the "behind-the-scenes" work is going to pay off. "We have a chance to show the rest of the state, the country and the world our heritage

Photo by Nancy Davis



Manteo Mayor John Wilson



and how our history has evolved."

But some Dare County merchants are worried that the festival may present problems. The events are scheduled during the peak travel season, when most of the available lodging on the Outer Banks is already filled to capacity and the two-lane road into Manteo is bumper-to-bumper.

The merchants felt the celebration should have been scheduled for the off-season. Unfortunately, history didn't cooperate, says John Bone, executive vice president of the Outer Banks Chamber of Commerce.

How many people does Bone think will converge on Manteo? That's anybody's guess, he says. But he adds that the merchants will be ready. "It's just another three-day weekend. Crowds in the summer are a fact of life here."

The crowd may be an unknown, but there are only a set number of rooms to be had in the county. A market study conducted by the Chamber of Commerce estimates a capacity for between 60,000 and 77,000 overnight visitors.

To alleviate some of the pressure for lodging, Rich Novak, Sea Grant's recreation specialist in Manteo, has been working with area residents interested in turning their homes into bed and breakfast lodging. Novak says this alternative offers travelers homey lodging and a light breakfast at reasonable prices. For more information about bed and breakfast businesses, contact Novak at 919/473-3937.

Whether visitors come for the day or spend the week, John Bone and the Chamber of Commerce have one thing in

mind. "Our main goal is for people to come to the festival, be attracted to the area and return," says Bone.

Charles Heatherly, Director of the N.C. Division of Travel and Tourism, says his department has advertised the three-year celebration in Florida, Ohio, New York, Pennsylvania, New Jersey and the suburban Washington, D.C. areas. But, the ads are scheduled to encourage travelers to visit in the spring and fall.

Neville is quick to point out that while July 13-15 is the big kickoff, the celebration will continue three more years. The 1985 festivities will focus on the 400th anniversary of the landing of Ralph Lane's colony. 1986 will be the year of the Indian. And in 1987, the state will close out the commemorative period by celebrating Virginia Dare's 400th birthday.

By 1987, the state and its residents may tire of celebrating events that happened 400 years ago. But at least they'll be a little more educated about their beginnings here in English America.

And, according to Manteo Mayor Wilson, it's about time. "History books give the Roanoke colonies nothing more than a paragraph. But we are first. We are before the others. Every school child across the country knows of the Pilgrims and Plymouth Rock. Everyone knows of Jamestown. And by the end of 1987, every school child in this country is going to know that Roanoke Island and the Raleigh colonies is, in fact, where it all started."

—By Nancy Davis

*Photo from Renaissance Development Co., Inc.*



*Rendering of the redevelopment of Manteo waterfront*



## The Roanoke voyages

# There's more than a Lost Colony

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For most people, Sir Walter Raleigh's colonization attempts hold a vague memory of a colony lost, but never found, and a child named Virginia. Ask folks what Ralph Lane, Arthur Barlowe and Sir Richard Grenville mean to Raleigh's efforts and they draw a blank.

But Raleigh sponsored three voyages to North America—one for exploration and two for colonization. All of these efforts involved a small island that today we call Roanoke.

Under a charter granted by Queen Elizabeth I, Raleigh's first expedition of two ships set sail from Plymouth, April 27, 1584, led by Philip Amadas and Arthur Barlowe. These explorers were charged with finding a suitable site for a subsequent colony.

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### April 1584—Amadas and Barlowe set sail from Plymouth, England

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Utilizing the circular wind patterns of the Atlantic Ocean, the expedition sailed south to the Caribbean, then north with the Gulf Stream. On July 13, 1584, the voyagers anchored off the Outer Banks, calling their anchorage Port Ferdinando after their pilot, Simon Ferdinando. They claimed the nearby land for their queen.

The English established friendly contact with the native Algonkian Indians soon after their arrival. They traded items such as clothing and tin cups for the Indians' deerskins and food.

After a trust had been built between the Indians and English, Barlowe and seven other men took a small boat to visit an Indian village on an island called "Roanoak" about 20 miles away.

No one knows how far the English explorers traveled during the 1584 ex-

pedition. Barlowe, who recorded a brief history of the voyage, wrote of an "inclosed sea" (probably the Pamlico Sound) and numerous islands. He also wrote extensively about the abundance of fruit, wild game, fish and forestland.

In August, the 1584 expedition set sail for England, taking two Indians,



*Raleigh never sailed on the voyages he sponsored*

Manteo and Wanchese. And, if Spanish reports are accurate, the ship commanded by Amadas stopped at Chesapeake Bay, where it met with hostility from the Indians there.

As a result of this expedition, Raleigh was knighted in 1585. The land discovered was named Virginia in honor of the virgin Queen Elizabeth and Raleigh was authorized as its lord and governor.

In April of 1585, Raleigh launched another expedition that included seven ships and 600 men under the command of Sir Richard Grenville. Also aboard were Ralph Lane, the governor of the colony; John White, an artist; Thomas Harriot, a scientist; and Manteo and Wanchese.

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### April 1585—Grenville and Lane set sail from Plymouth, England

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In the fight against the Spanish, Raleigh had charged this expedition with establishing a colony and a military outpost. The 1585 colonists were soldiers and adventurers who hoped to find quantities of gold and silver like the Spanish had found in Central and South America.

The Grenville expedition arrived off Cape Fear near the end of June. Then they explored the Pamlico Sound in small, shallow-draft boats. During this exploration, Grenville burned the Indian village, Aquascogoc, to force the return of a missing silver cup.

After this unfortunate incident, Grenville moved north to establish a colony on Roanoke Island in late July. One month later Grenville returned to England, leaving behind 107 men, a newly completed fort and the promise of return by Easter to replenish supplies.

In the fall, Lane sent an exploration party north to the Chesapeake. Some historians believe this party overwintered there before returning to Roanoke Island in the spring. During the spring of 1586, Lane also detached men to explore the Albemarle Sound and the lower waters of the Chowan and Roanoke Rivers.

Through drawings and notes, White and Harriot recorded much of what the colonists saw as they explored.



White made detailed drawings of the Indian villages. And together they drew the first map of North America, depicting the area between the Neuse River and the James River and inland to the head of the Albemarle Sound.

Unfortunately, much of their work was lost as they were leaving to return to England. Some of White's drawings survived to be displayed in the British Library in London. And Harriot wrote *A briefe and true report of the new found land of Virginia*, published in 1588 as the first English book about North America.

By the spring of 1586, Lane's supplies were scarce. No relief vessel had arrived from England. The soldiers had not bothered to plant fall crops, planning instead to depend on trade with the Indians for their food. But the English items of trade no longer presented an allure for the Indians. And, the Indians did not have enough food stored to regularly feed a colony of 100 men.

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#### June 1586—Drake transports Lane colony back to England

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Relations with the Indians soured. While Manteo remained a friend to the colonists, Wanchese turned foe. It is believed that he may have incited Wingina, king of the Roanoke Indians, to plan an attack on the English. Lane learned of the plot. After entering the Indian village under false pretense, Lane killed Wingina.

In June of 1586, Sir Frances Drake stopped at Port Ferdinando with supplies, equipment and men for the colony. Drake offered Lane a small ship to explore the Chesapeake for a better place of settlement. But a hurricane struck, sending many of

Drake's smaller vessels to a watery grave and others fleeing to England. After the storm passed, Drake had little to offer Lane except passage for the colonists back to England. Lane accepted the offer.

Many historians believe that Lane left behind three or four men who were exploring the Chowan River when the



*Elizabeth I provided limited funds for Raleigh's voyages*

colonists departed. These men may have been the first "lost colony."

Just two weeks after the Lane colony departed with Drake, Grenville arrived with supplies. Finding the colony site deserted, Grenville placed 15 to 18 men at the fort and returned to England.

Although Raleigh was discouraged by the return of his first colony, he

wasted no time in collecting a third expedition. The 1587 colony included women and children, and its pursuits were to be more agricultural than military. The colonists financed much of this expedition, probably in return for 500 acres they were each promised in the document that incorporated the "cittie of Raleigh in Virginia" under Raleigh's trust. John White was appointed governor.

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#### July 1587—White colony forced to make Roanoke Island its home

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The destination of this colony was to be Chesapeake Bay and what we today consider as Virginia. White did plan to stop at Roanoke Island to pick up the men left by Grenville. When White and 40 of his men disembarked to search for the Grenville party, Ferdinando, now in command of the vessels, told his sailors not to bring back any of the colonists except White. It seems Ferdinando had plans for waylaying several Spanish ships traveling in his return path.

Thus the third expedition was forced to make Roanoke Island its home. Of the fifteen men left by Grenville, only the skeleton of one man was found—thus a second lost colony arises.

The fort had been leveled and the houses abandoned. White immediately had the colonists restore the fort and repair the houses.

In a month's time, White returned to England for supplies. With his departure came the beginning of a mystery that has intrigued archaeologists and historians for years—the 1587 colony that was lost, but never found (see story, page 7).

—By Kathy Hart



# Ship sails through history

A foul stench rises from the sweaty bodies of the 50 passengers crowded in the dark hold of the 70-foot English vessel. The odor, made worse by molded bread and stale ale, cannot be eased by opening a window. The gun ports have been caulked shut for the two-month voyage to North America.

The passengers aboard the *Elizabeth*, one of seven vessels carrying colonists to Roanoke Island in 1585, were adventurers. They sought wealth, a possible North-West passage to the Orient and a military outpost.

Beginning this July, the events of Sir Walter Raleigh's second expedition to Roanoke Island will be recreated in Manteo on an authentic replica of the *Elizabeth*. Visitors can climb aboard the *Elizabeth II* and listen to costumed "living history" guides tell of their 16th century voyage.

Special care was taken to design and construct the *Elizabeth II* just like her prototype. Architect William Avery Baker, an expert of 16th and 17th century ships, was first commissioned to design the vessel. When he died in 1981, his work was resumed by Stanley Potter. By June, 1982, everything was shipshape when O. Lie-Nielsen of Maine began the construction in Manteo.

Like her 1585 counterpart, the *Elizabeth II* is completely handmade. Shipwrights cut each board by hand. And instead of using nails and screws, they joined the beams, frames and decks by wooden trunnels (pegs) and spikes. After 15 months of painstaking work, the craftsmen launched their finished product—a sea-blue, red and white replica sporting three towering masts and weighing more than 95 tons.

Stepping aboard the *Elizabeth II* is like stepping back 400 years into history. At the stern is the small captain's quarters with only a bedroll and a desk. At the bow, there is a beakhead that the seafarers used as a toilet. The remaining deck is home and workplace for the 25 or so mariners on the journey.

On the *Elizabeth*, there were about 12 categories of crewmen, says Lokey Lytjen-Collins, historian for the *Elizabeth II* Historic Site. The captain, believed to have been Thomas Cavendish, was in charge of the ship, its navigation and passengers. Often, a captain's mate and a navigator assisted him. Next in command was the pilot, Simon Ferdinando, who steered the ship. Petty officers, or boatswains, maintained the rigging and sails. Seamen and

Photo by Nancy Davis



Horace Whitfield, captain of the *Elizabeth II*

yonkers, the younger sailors, also worked with the riggings and on the deck. A ship's boy, or grommet, helped on deck.

A carpenter, cook and barber-surgeon took care of daily chores and problems, Lytjen-Collins says. The lowest mariner, the swabber, cleaned the deck and beakhead as punishment for not carrying his weight on the ship or for lying.

Below the deck of the *Elizabeth II* is the hold, the area where the passengers stayed. Underneath it, provisions, anchors, farming and building equipment, ammunition and a cannon were stored.

These hearty seafarers slept on straw ticks or mattresses, using a coil of rope for a pillow. A small fireplace toward the bow warmed the men and cooked them simple meals.

For dinner, they ate hardtack (sea biscuits) and salthorse (salted beef or pork), says Lytjen-Collins. But the hardtack usually became damp and molded, and the salthorse, full of maggots. Their ale tended to be green or stale after the first keg because the supplier knew they would be far out to sea and could not exchange it. Occasionally, the menu was supplemented with bread, cheese, honey and fresh fruits picked up in ports.

Entertainment for mariners on the *Elizabeth* included games of cards or dice, says Lytjen-Collins. Passengers may have taken along musical instruments such as tabors or flutes to bide their time. Because most of the voyagers were



of the lower classes, they did not read.

Evidence shows that the men, loyal to the Church of England, attended religious watches in the morning and evening. The captain led the daily prayers and hymns on the *Elizabeth*.

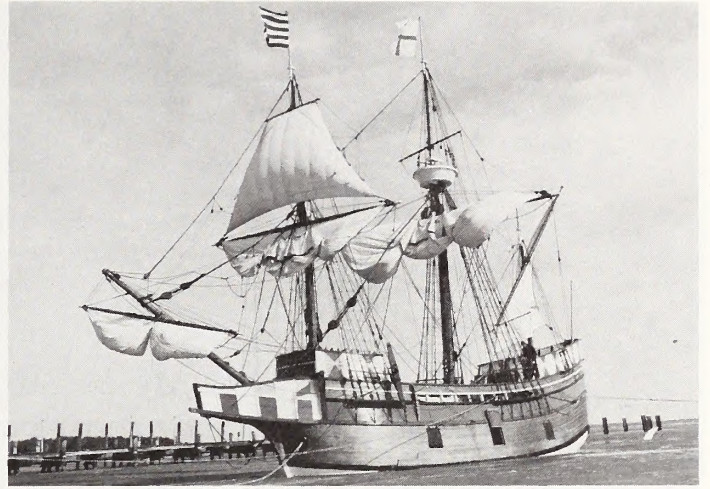
Unlike her 16th century double, the *Elizabeth II* will travel in and out of ports all along the North Carolina coast.

"One of the challenges to me is that we're going to encounter some of the same natural forces that they did 400 years ago," says Horace Whitfield, the ship's captain and manager of the state historic site. "I'm going to take that ship everywhere in North Carolina that she's capable of going."

It won't be as easy as it sounds, though, says Whitfield. "We've got to pick our way through 400 years of trash."

—Sarah Friday

Photo by Henry Applewhite



16th century replica will sail N.C. waters

## The Lost Colony

# Few answers to 400-year question

For almost 400 years, explorers, historians and archaeologists have been trying to solve a puzzle. But, the pieces don't fit. In fact, most of them—117 men, women and children—are missing.

What we know about Sir Walter Raleigh's final expedition to North American is limited. Most of the puzzle pieces come from the records of John White, writer, artist and governor of the 1587 colony.

White writes that the Croatan Indians, led by Manteo, helped the colonists by sharing their knowledge of the area and food. The English showed their appreciation to Manteo on Aug. 13, 1587, by baptizing him and making him a lord. This was the first Protestant baptism and the first granting of an English title in North America.

But not all the natives were as friendly. Hostilities flared with the Roanoke Indians when they killed colonist George Howe. White writes that he and more than 20 men retaliated by attacking the Indians' village a few days later. But instead of finding the Roanokes, they found the Croatans gathering corn. The Roanokes had fled after killing Howe.

In August, White left the island for supplies, but not before his granddaughter, Virginia Dare, the first

English-American child, was born on the 18th. Soon after, another child, whose sex and first name remain unknown, was born to Margery and Dionas Harvey.

White's accounts tell us little about the lifestyle of the 1587 colonists. Those puzzle pieces come from historians and archaeologists.

Historian Lokey Lytjen-Collins says

the colonists intended to make Roanoke Island more of a town in 1587, depending more on its own agricultural endeavors. Raleigh even gave them a coat of arms and a motto saying, 'Through harmony, small things grow.'

Historians believe the colonists lived in story-and-a-half or two-story dwell-

*Continued on next page*



CROATOAN — White's only clue to his lost colony





*"My belief is that, for the most part, the majority of the colonists made good their original desire or intention to go to the Chesapeake Bay."*

—Phil Evans

ings that resembled typical English homes—thatched-roof, half-timber or log structures.

The colonists brought tiles and bricks, but these were usually reserved for the governor's house or a church, says William Powell, professor of history at the University of North Carolina at Chapel Hill.

The colonists' lifestyle was probably simple, as it had been in England. Powell, who has done extensive research in England on the families of the Lost Colony, found that most of the men were laborers—tilers, bricklayers, farmers, cobblers. Powell says that some of them may have been graduates of Oxford and Cambridge universities.

The colonists ate and drank from simple pottery and wore plain dresses and breeches. They entertained themselves with activities typical of the day such as dancing, bowling, playing stringed and wind instruments and children's games.

To protect against possible Spanish attack, the colonists had coats of mail, guns, axes and a cannon, says Powell. For sport, the English used their weapons to hunt rabbits, birds and deer.

Fall and winter passed without word of John White and the needed supplies. At the time of White's return to England in 1588, friction had inten-

sified with Spain. The Spanish king was organizing his famous Armada for a naval attack on England. Elizabeth ordered all ships to remain in port for her country's defense. But White told Raleigh of his urgent need to return to the colony, convincing him to secure two small ships from Elizabeth—the *Brave* and the *Roe*.

But, White was not in command of the ships and they engaged in privateering on the way. The *Brave* was defeated in an attempt to overtake a French vessel, so both ships retreated back to England.

Raleigh had since turned his attentions to South America, hoping it would provide the wealth that Roanoke Island had not, says Lytjen-Collins.

In 1590, a year-and-a-half after the ruin of the Armada, White finally was able to sail to North America on a trip sponsored by merchants. On August 15, nearly three years after his departure, White set foot on the island again.

The next day, White's hopes were raised when he spotted smoke. White says the "smoake put us in good hope that some of the Colony were there expecting my returne." But no one was found.

Soon afterward, White found the letters *CRO* carved on a tree on a bank at the north end of the island. He

proceeded from there to the settlement site—only to find it deserted and "taken downe." But, White found another clue left by the colonists—the word *CROATOAN* carved on one of the entrance posts to the palisaded village.

Before White left in 1587, he asked the colonists to carve their destination on a tree if they left the island. If they had to leave because of an attack, they were to add a Maltese cross.

Thinking the colonists had retreated to the village of the Croatans, White and the mariners went back to their boats with the intention of sailing to Hatteras to look for them. But a storm blew up and the captain insisted that they go on to the Caribbean or back to England. Having no choice, White returned to England, never to see Roanoke Island or his family again.

Theories of the fate of Raleigh's Lost Colony abound. But none can be proved. The theory of Phil Evans, historian and park ranger at Fort Raleigh National Park in Manteo, is typical of most.

"My belief is that, for the most part, the majority of the colonists made good their original desire or intention to go to the Chesapeake Bay." And, "unfortunately, were just caught up in the vastness of the wilderness and the hardships that would come in living stranded on a completely different continent with a socially and culturally different group of people."

Powell says, "They may have gone to Croatan before going to Virginia, or maybe divided." There also is speculation that the colonists traveling north were killed by two bands of Indians.

"I think archaeology will be the answer," Powell says, adding that the colonists were bound to have taken some metal or other objects on their trek.

The mystery surrounding the colony's disappearance has whetted the imagination and curiosity of many people, but it wasn't until the late 1800s that any serious research was done. About 50 years later, in 1941, Congress granted the National Park Service care of the fort.

After World War II, National Park Service archaeologist Jean Carl Harrington undertook a thorough investigation of the area encompassing the 1585 fort. His work resulted in the reconstruction of the fort on what he believes to be original site. And he



found indications of houses where the colonists may have lived. Researchers with the National Park Service continue to search for clues today.

The 400th Anniversary Committee also is sponsoring research on the Lost Colony. David Phelps, an archaeologist at East Carolina University, is searching for the Indian villages. And Gordon Watts, co-director of the maritime history and underwater archaeology program at ECU, will conduct a series of underwater tests in the late summer or fall of this year.

Watts believes that because there has been a considerable amount of ero-

sion and a 4-foot rise in the tide during the past 400 years, that the former settlement may be located in the sound. One-third of a mile off the north end of the island, Watts and his crew will scan the bottom of the sound with sonar and attempt to detect metals, brick footings and the like with a proton-precession magnetometer. If sufficient data is found, actual diving and more testing will take place next year.

Like Watts, many hope that one day the pieces of this giant puzzle will be found. But others, intrigued by the mystery, don't want it to end.

—By Sarah Friday

Photo from UNC News Bureau



William Powell

Theodor de Bry engraving of a John White drawing



Roanoke chieftain

## Sifting native soils

Beneath tilled Carolina farmland rest the secrets of an Indian civilization here long before the British were even aware of the New World. Today, much of that civilization is as lost as the Roanoke colony of 1587.

But with the help of modern archaeology, we may find some clues. As part of the 400th Anniversary Celebration, archaeologist David Phelps is sifting the soils of coastal Carolina in search of some of the Indian villages the English visited 400 years ago. His work is sponsored by the American Quadricentennial Corporation with funds from the Z. Smith Reynolds Foundation.

Much of what we know of the Indians comes from colonists' accounts and from John White's drawings. Phelps has uncovered additional information, piece by piece.

The people of the northern tidewater zone of North Carolina in the 16th century are known collectively as the Carolina Algonkians, says Phelps. They were divided into about 16 societies or separate sociopolitical units, each governed by a king.

While popular myth portrays Indians as savages on the verge of starvation, the Algonkians were a well-developed agricultural society. In fact,

says Phelps, the colonists might have starved if it hadn't been for the Indians' farming expertise. They donated food to the hungry Englishmen and taught them how and what to plant.

"English agricultural practices didn't lend themselves to the North Carolina climate. It would have taken a long period of adjustment and trial-and-error had they not had the knowledge and experience from the Carolina Algonkians," says Phelps.

These days, North Carolina farmers are not only plowing the same fields the Indians used years ago; they're growing the same crops. The English colonists reported the Indians grew corn, beans, squash, pumpkins, gourds, tobacco and sunflower.

The Indians' agricultural system operated on the slash-and-burn method, says Phelps. When the soil of one field was exhausted, they'd move to another, clearing the land by cutting and burning. The Indians probably used a field two to four years before they abandoned it.

When the English arrived, the Indians gave them farmland. But Phelps has a theory that the Indians were donating land that they were already

Continued on next page



planning to abandon.

Recently, Phelps has been excavating the village of Chowanoke on the west bank of the Chowan River in Hertford County. In March 1586, Ralph Lane visited Chowanoke probably the most powerful of the Carolina Algonkian villages.

This spring, Phelps and his crew tested what he believes is the public area of the village where the political and religious buildings would have been. Early findings indicate that much of the evidence is still intact.

The town, which extends for about a mile along the river, was occupied from about 825 to 1644, says Phelps. At least 30 houses, some as wide as 40 feet and as long as 150 feet, housed clans or extended families. On that basis, Phelps estimated that 7,000 to 10,000 Indians lived along the Chowan River in the 1500s.

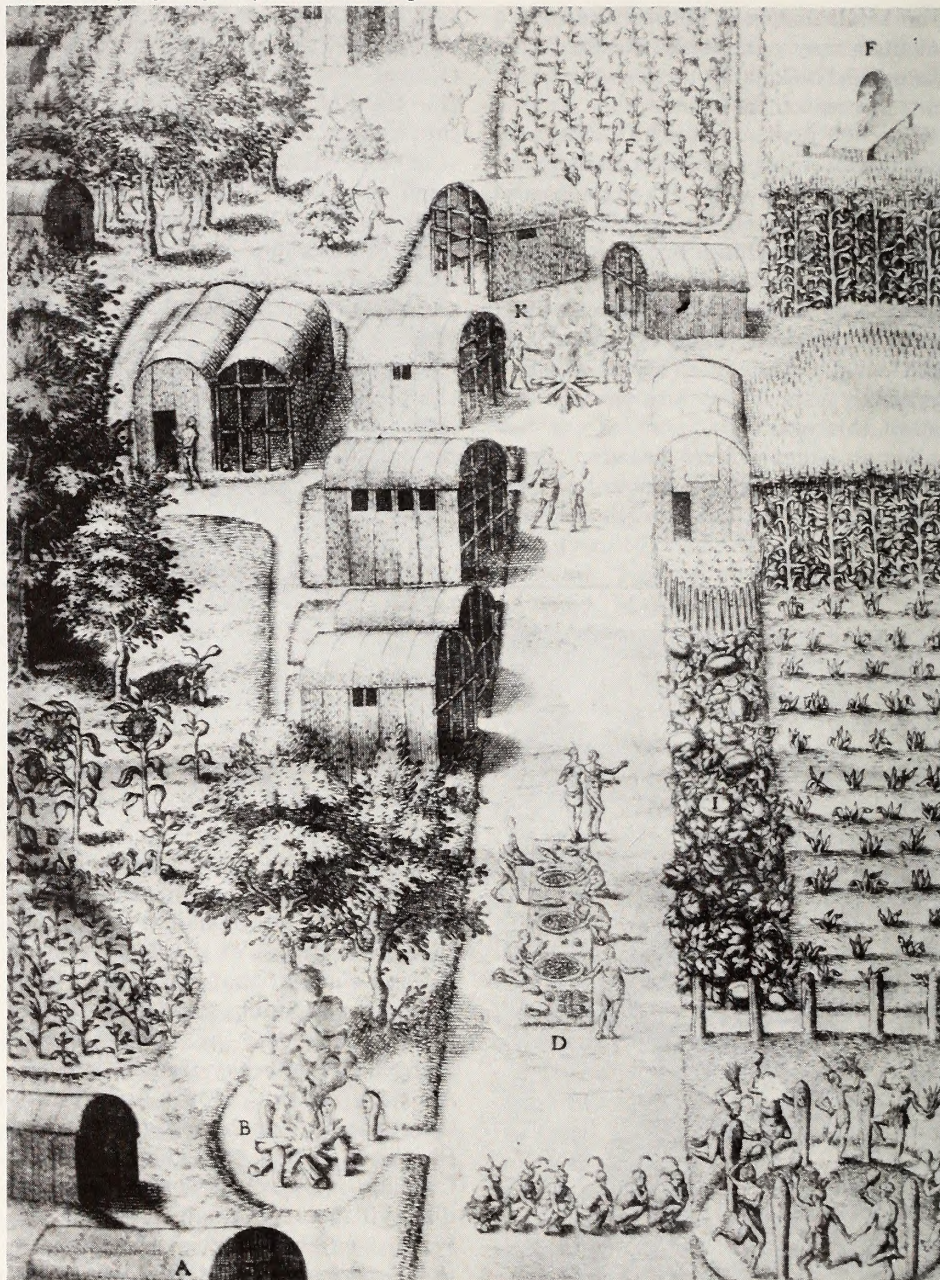
The population of the Chowanoke society was probably higher than other Algonkian societies, says Phelps. The fertile farmland along the Chowan supported greater numbers than the sandy soils of Roanoke Island and the Dare mainland, he explains.

Phelps doesn't have to dig far to find clues of life 400 years ago. Most of the evidence is directly under the "plow zone," he says. In addition to the post patterns of houses, the excavations have uncovered the remains of cooking pots, drinking vessels, weapons, bone tools and ornaments, axes, stone knives and shell beads.

Those Algonkian relics are all that's left now. The first English attempt at a colony may have failed, but English America eventually flourished. The Indians weren't so lucky.

—By Nancy Davis

Theodor de Bry engraving of a John White drawing



16th century Algonkian Indian village

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, NCSU, Box 8605, Raleigh, N.C. 27695-8605.

Name \_\_\_\_\_

Address \_\_\_\_\_

City•State•Zip Code \_\_\_\_\_

I am in the following line of work:

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|---|--|
| <input type="checkbox"/> Boatbuilding/Repair    | <input type="checkbox"/> Marina operator                 |
| <input type="checkbox"/> City/County government | <input type="checkbox"/> Marine recreation               |
| <input type="checkbox"/> Commercial fishing     | <input type="checkbox"/> Mass media                      |
| <input type="checkbox"/> Educator               | <input type="checkbox"/> Seafood processing/marketing    |
| <input type="checkbox"/> Farming                | <input type="checkbox"/> State government                |
| <input type="checkbox"/> Homemaker              | <input type="checkbox"/> University professor/researcher |
| <input type="checkbox"/> Lawyer                 | <input type="checkbox"/> Other _____                     |

Coastal property owner ☐ yes ☐ no Boat owner ☐ yes ☐ no



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities — on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454). For copies of publications, write UNC Sea Grant, NCSU, Box 8605, Raleigh, N.C. 27695-8605.*



Wayne Wescott, marine advisory agent on Roanoke Island, was recently named the Sea Grant Southeast Marine Advisory Service's Agent/Specialist of the

Year. Wescott was chosen for his work with the soft-shell crab industry.

When Wescott began his project, only a few commercial fishermen were aware of the profit possibilities in a soft-crab production. But Wescott sold them on the idea of shedding. The bottom line was this: At the beginning of the 1983 crabbing season, the highest recorded price for hard crabs was \$1 per pound. At the same time, soft crabs were bringing as much as \$2.33 each or \$28 per dozen.

Wescott went to work, compiling information, visiting shedding facilities, and presenting workshops. An article in *Coastwatch* on soft-shell crabbing resulted in several hundred requests for information. And his book, *A Guide to Soft Shell Crabbing*, was distributed to over 800 people during the first month after its publication.

In 1983, as a result of the increased interest, more than 100 crabbers began to cull out peelers—a five-fold increase from 1982. Over 50 new shedding facilities were constructed, resulting in an estimated additional \$2 million in gross sales of soft crabs.

Now, shedding facilities have been set up in almost all coastal com-

munities in Dare and Currituck counties. In Currituck County, Wescott worked with zoning officials to establish conditional use permits to allow fishermen to build shedding facilities on their property in residential areas.

Wescott says his soft-crab industry project isn't over yet. If you have questions about soft-shell crabbing, contact Wescott at the N.C. Marine Resources Center/Roanoke Island, P.O. Box 699, Manteo, N.C. 27954 or call 919/473-3937.

Michael Orbach, a maritime anthropologist at East Carolina University and a Sea Grant researcher, will teach a course about marine policy at the Duke University Marine Laboratory in Beaufort from July 16 to August 17.

The course will introduce students and marine-policy professionals to the study of marine policy and policy-making. Course participants will trace the history of marine-related organizations, legislation and issues, and their effects on local, regional, national and international policies.

The course may be taken for credit at either Duke University or the University of North Carolina at Chapel Hill. Students may enroll up until the first day of class.

For admissions information, contact the UNC Institute of Marine Sciences, 3407 Arendell St., Morehead City, N.C. 28557 (919/726-6841) or Duke University Marine Laboratory, Beaufort, N.C. 28516 (919/728-2111).



At the North Carolina Marine Resources Center at Fort Fisher, visitors are coming face to face with sharks. The feared fish are at home in their new 17,000-gallon shark tank. And, they're willing to meet the public.

The tank is 28 feet long, 7 feet deep and over 13 feet wide. That makes it

one of the largest free-standing fiberglass aquariums in the world, says Jim Lanier, director of the center. Most tanks are made of concrete.

The new inhabitants of the tank will be sharks caught from North Carolina waters. The largest of the eight species to be represented in the tank will be about 5½ feet long.

Lanier says the aquarium will show folks that there's more to a shark than big jaws and big teeth. "We're going to use that exhibit to teach them about the hydrodynamics of how fish swim, about fish physiology, about the value of sharks for research, the value of sharks as food. We're going to capitalize on that interest to teach people an awful lot about the sea."

The shark tank was donated to the center by the Telephone Pioneers of America.

For more information on the new aquarium, call 919/458-8257.



After a hard day's work in the field back in 1587, colonist Ananias Dare probably thought there was nothing better than a hot meal served up in a panchon and a corrugated bowl.

Not much is known about the Dares or any of the other members of the Lost Colony, but artist Jan Mann has an idea of what the pottery they used may have looked like. She and her husband, owners of Wildflower Pottery in Godwin, N.C., were commissioned by America's 400th Anniversary Committee to recreate 16th-century eating and drinking vessels.

Their work is on display and for sale in many places including the site of the *Elizabeth II* in Manteo and the N.C. Museum of Natural History in Raleigh. If your school or library would like to see some of their work, Jan and her husband have donated a set to UNC Sea Grant for educational loan. The collection includes drinking

*Continued on next page*



jugs, bowls, pancheons (plates) and other reproductions.

Also, Sea Grant has available a treasure chest of ship artifacts. It includes samples of wood that are similar to those used in building the *Elizabeth II*, spikes, rope, hemp and other nautical pieces.

Both collections can be borrowed from Lundie Spence, Sea Grant's marine education specialist, or from the regional social studies coordinator in your area. The collections cannot be mailed, so users must provide a means of transporting them.

For more information, write Spence at UNC Sea Grant, Box 8605, Raleigh, N.C. 27695-8605.

There's more to know about the beach than sloughs and sand castles, and Lundie Spence, UNC Sea Grant's marine education specialist, is helping to teach educators about North Carolina's coast.

Spence will assist in the "Coastal and Marine Science Workshop" to be held July 23 to 25 at Elizabeth City State University. The workshop is co-sponsored by the university and UNC Sea Grant.

The two-day workshop, organized for educators teaching grades 5 to 9, will include programs on coastal and marine geology and ecology, estuarine field studies and trawling. Information on classroom activities also will be provided.

Larry Giardina is Sea Grant's new marine advisory agent at Bogue Banks. Advisory Service Director Jim Murray says Giardina will be developing applied research and extension programs for seafood marketers. And, he'll be promoting North Carolina seafood through marketing and merchandising.

If you'd like to contact Giardina, write him at the N.C. Marine Resources Center/Bogue Banks, Box 896, Atlantic Beach, N.C. 28512, or call 919/247-4007.



Teenagers will take a first-hand look at coastal habitats in the 4-H Marine Environment Workshop August 5-10 at the Bogue Banks Marine Resources Center and Mitchell 4-H Camp in Swansboro. Activities will include marsh habitat studies, beach investigations, trawling, snorkeling, laboratory studies and more.

The workshop is sponsored by the N.C. 4-H Program, the N.C. Marine Resources Centers and UNC Sea Grant. The workshop is one in a series of 4-H activities that have grown out of a Sea Grant project conducted in 1981 and 1982 to promote marine awareness.

Registration is open to teens ages 14-18 and is not limited to 4-H mem-

bers. The fee for the week-long workshop, including meals, lodging, insurance, equipment fees and field trips, is \$125.

For more information, contact Jaynee Medlicott, Box 7606, North Carolina State University, Raleigh, N.C. 27695-7606 or call 919/737-3243.

The new writer in Sea Grant's communications office is Sarah Friday. She joins Kathy Hart and Nancy Davis as a staff writer for *Coastwatch*. She'll also help produce Sea Grant advisory publications, brochures, news releases and public service announcements. Friday, a graduate of the University of North Carolina at Chapel Hill School of Journalism, comes to Sea Grant from *The News and Observer* in Raleigh.

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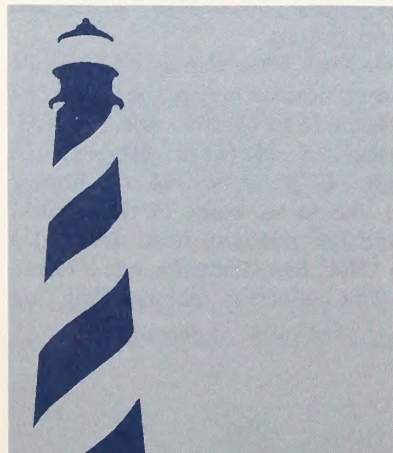
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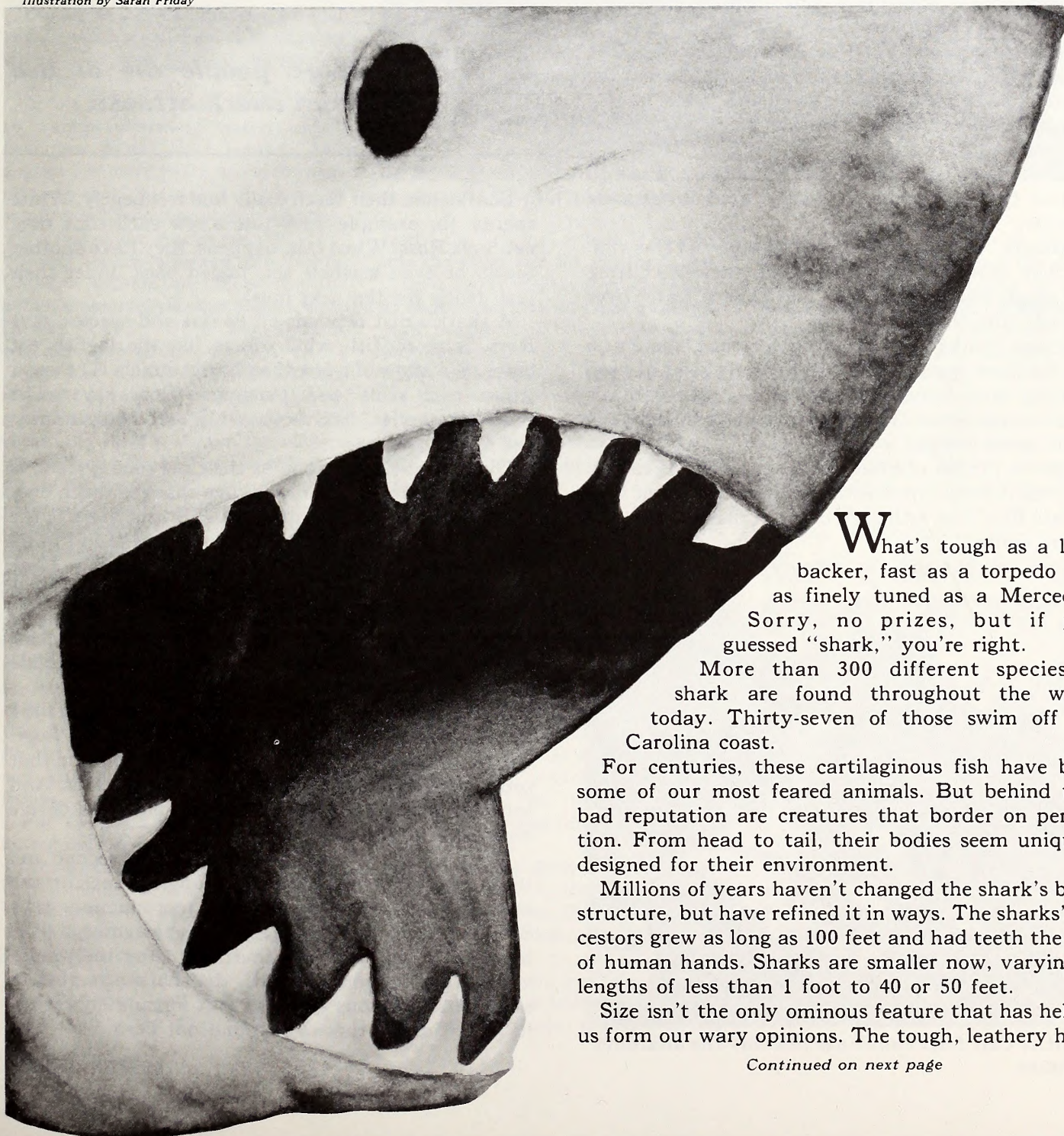
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# COAST WATCH

*Illustration by Sarah Friday*

What's tough as a line-backer, fast as a torpedo and as finely tuned as a Mercedes? Sorry, no prizes, but if you guessed "shark," you're right.

More than 300 different species of shark are found throughout the world today. Thirty-seven of those swim off the Carolina coast.

For centuries, these cartilaginous fish have been some of our most feared animals. But behind that bad reputation are creatures that border on perfection. From head to tail, their bodies seem uniquely designed for their environment.

Millions of years haven't changed the shark's basic structure, but have refined it in ways. The sharks' ancestors grew as long as 100 feet and had teeth the size of human hands. Sharks are smaller now, varying in lengths of less than 1 foot to 40 or 50 feet.

Size isn't the only ominous feature that has helped us form our wary opinions. The tough, leathery hide;

*Continued on next page*



a perpetual frown; and that mouthful of sharp, pointy teeth have haunted more than one nightmare. But, it all adds up to a vertebrate proficient in achieving its sole objective—survival.

One means of protection for the shark is its thick, rough skin. It's rough because it has denticles, or microscopic teeth, embedded in it. These unusual structures are actually prototypes of the teeth found in the shark's mouth, says Steve Ross of the N.C. Division of Marine Fisheries in Morehead City.

Whether a shark is escaping or pursuing, its streamlined body, dorsal tail and assorted fins maneuver it quickly through the water. As with most fish, the fins move water across gill slits on the sides of the shark's head, keeping a constant flow of oxygen going into its body.

For buoyancy, fish have an internal swim bladder that changes amounts of air and gas according to movements. Sharks, on the other hand, don't have a swim bladder and must maintain buoyancy in two other ways, says Ross.

Sharks have a giant liver that is full of oil. Since oil is lighter than water, the liver acts "kind of like a life preserver," Ross says.

Secondly, he says, most sharks constantly swim. "As they move through the water, there's a lifting force much like an airplane. The flow of water over the body lifts them up."

Because sharks must move all the time, there's no sleep for most species. They don't really require sleep anyway, says Lundie Spence, UNC Sea Grant's education specialist. The shark's brain is so small, it doesn't need resting.

High on the list of priorities for the shark is eating. To do so, it is equipped with "mechanisms" that help it locate food and with a set of teeth that would scare off any dentist.

Those mechanisms, or sensory organs, are very



Scientist Carl Luer continues to study the anatomy of sharks.

well-developed, says Ross. Sharks have an acute ability to detect low-frequency vibrations such as those set off by a struggling fish. They also can smell objects long distances away with nostrils located underneath their head. This combination allows sharks to quickly home in on their prey.

For years, it was believed that the glassy eyes of a shark could only see blurry, mottled shapes. But research shows that sharks can discern color and fairly definite shapes—a handy feature around mealtime.

Carnivorous sharks tear into their dinner with up to 1,000 sharp, white teeth. Ross says each species has a set number it can replace indefinitely. A few have no teeth at all.

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*Each year, more people die of bee stings than from shark attacks.*

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Sharks lose their teeth easily and frequently. White sharks, for example, may lose a few each time they eat, says Ross. When that happens, they have another tooth, or even a whole set, folded back under their jaw, ready for the next meal.

A shark's diet depends on its size and species, says Ross. Some eat fish, while others, like the dogfish, eat crabs. We know of a few that eat mammals. The great white eats seals and penguins, Ross says. The toothless species, like the basking and whale sharks, eat plankton.

Their digestive system, as their nervous system, is relatively primitive. Neither have changed much over the years. Another primitive facet of the shark is the high concentration of salts and minerals found in its blood, says Spence. The shark urea stores a large quantity of salt in the shark's body, which prevents it from dehydrating quickly.

With all this finely-tuned survival equipment, sharks can live 20 or 30 years. Their most vulnerable stage in life, however, is the first.

Sharks reproduce in three ways that vary with the species. Some females lay eggs on the ocean floor. Others produce eggs surrounded with a yolk sac that provides nutrients to the embryo as it develops. And some form eggs that attach to the womb and derive nutrients from it.

The majority of sharks are born by the second and third methods, which produce young, or pups, in the womb. With the third type of reproduction, says Spence, usually only the first-developed embryo lives because it eats the others that later enter the womb.

From conception to death, the shark attempts to satisfy its voracious appetite. But fortunately for us, its affinities are toward fish and not flesh.

—Sarah Friday



# The name of the catch is shark

Photo by Nancy Davis

There aren't many folks who'd like to see the toothy jaws of a shark snapping in their faces. But that's exactly what Lloyd Davidson of Morehead City wants. He's one of a rare breed of commercial fishermen who stalk North Carolina's waters for shark.

For two to three days at a time, Davidson rigs up his boat, throws out his lines, and reels in some of the most dangerous, but delicious, fish that lurk the deep.

During the winter months, he and two crewmen go offshore 30 to 40 miles where tiger and sandbar sharks are plentiful.

In the summer, when sharks move to warmer nearshore waters, shark fishermen follow close behind. And anglers are more likely to catch them off piers then. Silky, dusky, black-tip, spinner, bull, sandbar and tiger sharks are a few of the species caught.

Other types snagged off North Carolina include the blue, dogfish, white, mako and thresher sharks, says Lundie Spence, UNC Sea Grant's education specialist.

Jim Bahen, the UNC Sea Grant marine advisory agent at Ft. Fisher, says, "Anytime you go fishing in the ocean . . . there's always the chance you'll catch a shark," no matter what you're fishing for.

Davidson got hooked into commercial shark fishing last year when he and the owners of a Morehead City fish market thought there was a demand for the meat in Northern markets.

The first step was to rig his 41-foot boat. This is the minimum length that should be used, says Davidson, because you need room for longlining and for the proper facilities to prepare the shark once onboard. Davidson figures that it costs between \$5,000 and \$10,000 to rig a boat for shark fishing.

For Davidson and his crew, each outing operates more like a hunt than a fishing trip. Instead of fishing poles, they use miles of cable and nylon line attached to two huge, hydraulic reels that will pull in their catch. Hooks are spaced 30 to 50 feet apart on each line. For bait, almost any fresh fish will do, says Davidson, and if it's bloody—that's even better. When the hooks are



*Lloyd Davidson on the Alligator*

ready, the "chum," or bait, is dropped into the water and the waiting begins.

On a good day Davidson catches 15 to 20 sharks. Hooking them is the easy part, though. One by one, the sharks must be killed.

The methods are primitive, and all are dangerous for the fisherman. To kill sharks, fishermen club them, drag them by the tail until they suffocate, shoot them in the head or tie them around the gills.

When the shark is dead, it is hauled over the stern, gutted, then bled by cutting off the tail, fins and head. Shark blood contains high concentrations of urea that can convert to ammonia and taint the flesh if not drained promptly. The tough skin of the shark can be removed now or after freezing. The remaining carcass, or meat, is thrown into a tall vat of ice as the next shark is pulled aboard.

In all that time of working at what Davidson calls "a fairly grizzly operation," he still has 10 fingers and 10 toes. And he doesn't have any scars or "Jaws" stories.

But, Thomas Blevins does. A sport fisherman and a UNC Sea Grant research technician, Blevins came face-to-face with a female spinner that wasn't willing to give up. She thrashed, extended her jaws, jumped at the boat lights and bit at the rope. With only his brother to help him, and

a rod and reel to pull her in, Blevins finally succeeded in landing the shark.

This kind of excitement is what keeps Blevins searching for shark. He usually goes out in his 19-foot boat with his brother and another crew member. He uses a large rod and a reel with 400 to 700 yards of 80-pound braided dacron line, an amount he advises other shark fishermen to use.

Like Davidson, Blevins chums for shark. Blevins can usually guess the size of the shark by how fast it takes the bait. Smaller sharks rush up to the bait, grab it and run, he says. But when the big ones are around, his reel clicks slowly and continuously, like a bomb about to explode.

Most fishermen are not as fond of reeling in a shark as Davidson and Blevins. In fact, sharks are a nuisance to many anglers because they tear off bait and scare away other fish, says Bahen. Some fishermen shoot or club the fish and leave them on the beach. Bahen says he'd rather see anglers cut the shark loose and let it go.

Recreational fishermen just don't want to take the time or trouble to clean the sharks they catch, he says. But Bahen thinks that with a little more education about cleaning techniques and about the shark's tasty meat, more anglers will be inviting sharks to dinner.

—Sarah Friday



## Marketing shark

# Rough waters ahead for fishery

Lloyd Davidson's 41-foot *Alligator* is rigged for shark fishing. But lately, the Morehead City fisherman and his boat spend more time at the dock than out on the water. The prices his catch brings—when he can find a buyer—aren't enough to pay the costs of fishing.

It's a familiar story for Davidson. About a year ago he made a deal with the owners of a local fish house. He would rig his boat for shark fishing, and the fish house would market his catch. They had an idea that there was a demand for shark in the North, and they were willing to take a risk to get a jump on that market.

But now, with their venture in its second year, the experimenters say they may have jumped too soon. They're not ready to pull out, mind

you. They just want to warn others that there's rough water ahead before a strong shark fishery is established.

"I think the number one thing to say about shark fishing is not to encourage people to get into it yet. It's only marginally feasible now," says Davidson. The problem is, "You've almost got to talk people into buying it."

Doug Brady, an owner of Ottis' Fish Market in Morehead City, markets Davidson's catch—a task he likens to begging. Brady gives an example: if he had 5,000 pounds of shark meat today, he estimates it would take him 24 hours on the telephone to sell it.

Brady managed to convince some buyers in the North and West to purchase Davidson's shark. But he adds that his target market defies

regional borders—he'll sell to "whoever will buy it."

"There is some demand," Brady says. "But if you catch a lot, that demand will cease. You can fill up the demand quickly."

Concentrating on domestic markets, Brady sells fresh shark, headed and gutted, in the carcass form. His buyers chunk and steak the meat for retailing.

Traditionally, there has been a foreign market for shark fins, used in the Orient as a main ingredient in shark-fin soup. But Brady says the fishermen handle the marketing of the fins.

At the start of the shark venture, Brady intended to develop a product out of shark meat. He tested various forms, including patties, steaks, fillets, fish cakes and fish sticks. Brady reports mixed results. He'd like to see food scientists evaluate shark meat for use in such products.

There are other hurdles. "We're in the wholesale fish business," says Brady. "We make our money on volume. But we can't get a consistent supply. We need tons of shark."

Davidson says his catches are inconsistent because his is the only boat fishing specifically for shark. On some days, he catches as much as 7,000 pounds of carcass. On other days, his hold is empty.

The N.C. Division of Marine Fisheries estimates that commercial fishermen landed 136,702 pounds of shark in 1983, at a value of \$280,399. As part of a marketing program for North Carolina seafoods, the division may evaluate the potential for a shark fishery, says Director Bob Mahood.

Virginia Slosser, a fishery marketing specialist with the National Marine Fisheries Service, completed a study in 1983 on shark marketing on the East Coast. She believes there is a potential for a fishery. But she adds that the question is when.

U.S. fisheries statistics estimate the 1983 commercial landings of un-

Photo by Scott Taylor



*This surprise catch could have been marketed if properly handled*



*"I think the number one thing to say about shark fishing is not to encourage people to get into it yet. It's only marginally feasible now."*

*—Lloyd Davidson*

classified sharks at 4,700,000 pounds. ("Unclassified" is a designation that excludes dogfish, because it has been previously marketed.)

In the southeast region, the value of the commercial catch has increased 50 percent in the last three years, says Slosser.

Slosser says the key to a successful shark fishery will be a strong domestic market; fishermen can't rely on foreign markets. But achieving a market will take a lot of education, beginning with the fisherman who must learn to handle shark properly and reaching to the consumer who must learn to accept an underutilized species, says Slosser.

Recently, Davidson took a break from shark fishing when the market

declined. He explains: "Fish prices in general went down and people usually use shark as a cheap alternative to higher-priced fish. And swordfishing picked up and a lot of shark is landed as a byproduct of that." That put more shark on the market when people could get other fish for reasonable prices.

For all their doubts about the viability of the shark fishery, Davidson and Brady admit the picture isn't all bleak. Brady says he has seen more people catching sharks on charter boats. Rather than killing them and tossing them overboard, they're handling them properly, taking them home and eating them.

If sport fishermen use the sharks they catch, it will indirectly benefit marketers like Brady. More folks will find out shark is good eating and will buy it.

Inland North Carolinians are being introduced to shark via the grocery store. Each week, a Raleigh store sells about 25 pounds of shark caught from North Carolina waters at a cost of \$2.99 to \$3.99 per pound.

Now, Davidson is among the few East Coast fishermen longlining specifically for shark. His boat may be tied at the dock, but he insists that when the price is right, he'll be ready. And other fishermen are sure to follow.

*—Nancy Davis*

## Shark: a dish in good taste

Sharks may be terrors in the ocean, but that hasn't kept them from falling victim to human jaws. In England, folks sink their teeth into fish 'n' chips made with shark. And for centuries, Orientals have prized the fins for use in shark-fin soup.

But Americans seem more squeamish about what they eat. And until recently, most of us haven't seen fit to include this well-known predator in our diets. But now, more folks are gathering up the courage to bite into the feared fish.

And with good reason, says Joyce Taylor, UNC Sea Grant's marine advisory agent at the NCSU Seafood Laboratory in Morehead City. Shark is nutritious and economical, and its lean, white meat has a mild flavor and a firm texture. While the results aren't in yet, food nutritionists say shark is like all fish—high in protein, iron and niacin, and low in calories, fat and carbohydrates.

And there are no bones about a shark. That means the meat yield is higher for shark than for most other fish. Only 20 percent of a bony fish's weight is edible. But 42 percent of a shark is edible.

Taylor says shark meat tastes much like other fish. To prove her point, she did some experimenting. She cut some shark into inch-wide strips, and battered and fried the meat. Then she fed it to some willing participants, without telling them what they were eating. Most of her subjects identified the fried fish as croaker.

People like the taste of shark if it's been handled properly, says Taylor (see story, page 3). That means gutting and bleeding it as soon as it's out of the water, then icing it immediately. "If it's been poorly handled, it's not going to taste good and you're not ever going to buy it again," says Taylor.

If you're sold on the idea of trying shark, Taylor has some tips to ensure that you'll like that first bite. She recommends soaking shark, even if it's fresh. Soak the meat for at least an hour, preferably longer, in a solution of white vinegar and water ( $\frac{1}{2}$  cup vinegar to 1 gallon of water); lemon juice and water ( $\frac{3}{4}$  cup lemon juice to 1 gallon of water); or salt and water (1 cup of salt to 1 gallon of water). Taylor says any of these mixtures will help neutralize ammonia that may be left in the flesh of the shark. But she cautions that no amount of soaking will improve a shark that wasn't handled properly when it was caught.

Taylor buys shark in large chunks. Then she either cuts it into cubes, strips or fillets, depending on how she's going to cook it. For frying, cut the meat into 1-inch cubes or into strips about 3 inches long and 1 inch thick. Shark, like other fish, will flake when it's done.

If we've convinced you to give shark a taste, try the recipes on the next page. But don't let these limit you. Taylor says shark is great broiled, kebabled, baked, poached, barbecued, sauteed, or in soups and salads.

*—Nancy Davis*





# Here's your chance to bite back

## Shark Creole

*1 pound shark fillets, cut into 1-inch chunks*  
*1/3 cup vegetable oil*  
*3 tablespoons flour*  
*1 cup hot water*  
*1/2 cup chopped green onions, with tops*  
*1/4 cup chopped green pepper*  
*1/2 cup chopped parsley*  
*4 cloves chopped garlic*  
*1 1/2 teaspoons salt*  
*dash cayenne pepper*  
*1/2 teaspoon thyme*  
*bay leaf*  
*lemon slice*  
*1 10-ounce can tomato puree*  
*cooked rice*

Heat oil in large skillet and blend in flour over medium heat, stirring constantly until brown. Add water gradually and cook until thick and smooth. Add remaining ingredients except rice. Cover and simmer for 15 minutes. Remove bay leaf and serve over cooked rice. Serves 4-6.

## Shark shish kebab

*charcoal grill or hibachi*  
*2 pound shark fillet cut into 1-inch cubes*  
*12 cherry tomatoes*  
*3 purple onions, quartered and separated*  
*3 cans chunked pineapple, with juices*  
*3 green peppers, cut in large pieces (blanched if desired)*  
*fresh mushrooms*  
*1/4 cup soy sauce*  
*3 tablespoons lemon juice*  
*1/2 cup oil*

Cut fillets into 1-inch cubes. Soak for an hour in a salt, lemon juice or vinegar solution (see story). In the refrigerator, marinate shark cubes in soy sauce, lemon juice, oil and 1 cup of pineapple juice. Place shark cubes and vegetables on skewers and cook about 15 minutes, basting with the marinade. Serves 6.

## Fish 'n' Chips

### Batter

*1 cup flour*  
*1 egg yolk*  
*4 tablespoons beer*  
*1/4 teaspoon salt*  
*5 tablespoons milk*  
*5 tablespoons cold water*  
*1 egg white*

Pour flour into large bowl. Make a well in center and add egg yolk, beer and salt. Stir until well mixed. Combine milk and water and add half to batter. Stir until smooth. Add remainder, 1 tablespoon at a time, adding only enough to give right texture. For light texture, let batter rest at room temperature for at least 30 minutes. Beat egg white stiff. Fold into batter.

### Chips

*2 pounds baking potatoes*  
*vegetable oil or shortening*

Slice potatoes into 1/2-inch-wide and 1/2-inch-thick strips. Heat oil in deep-fryer to 375 F. Dry potatoes and fry until crisp and light brown. Transfer to lined pan to drain and place in 250 F oven to keep warm.

### Fish

*2 pounds fresh shark fillets*

Cut dressed and skinned fish into 3- by 5-inch pieces. Wash in cold water and dry completely. Drop 2 or 3 pieces at a time into batter. When well coated, plunge into hot oil. Fry 4 to 5 minutes, or until golden brown.

To serve, heap fish pieces in the center of a large heated platter and arrange chips around them. Traditionally, fish and chips are served sprinkled with malt vinegar and salt. Serves 4.

(For more recipes or cooking tips, call Joyce Taylor, Sea Grant's seafood agent at the NCSU Seafood Laboratory in Morehead City, 919/726-7341.)





# THE BACK PAGE

"The Back Page" is an update on Sea Grant activities — on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454). For copies of publications, write UNC Sea Grant, NCSU, Box 8605, Raleigh, N.C. 27695-8605.



When you get the itch to spend some time outdoors this summer, don't forget about mosquitoes. On North Carolina's coast, salt marsh mosquitoes are more numerous, more aggressive and can fly longer ranges than inland species. They'll also bite during the day, says Nolan Newton, head of the Vector Control Branch of the N.C. Division of Health Services.

Mosquito season varies each year according to the weather, but usually runs from April until October, says Charles Apperson, an extension entomologist at North Carolina State University. Heavy rains and high tides bring the potential for mosquitoes.

"Adult female mosquitoes lay their eggs in depressions in the salt marsh that are going to be flooded by rains or high tides," says Apperson. The eggs hatch when these sites are flooded. They quickly pass through several aquatic life stages before becoming adults.

Thousands of mosquitoes can hatch from such a brood, fly inland and disperse. In six or seven days, the female mosquito is mature enough to bite, says Apperson.

Mosquitoes bite us because they are attracted to our body heat and the moisture, vapor, carbon dioxide and sweat in our skin, says Apperson. Only the female bites because it needs to

collect the proteins from blood to produce eggs. When this is done, she flies to the breeding site to lay her eggs.

Apperson recommends using repellents to ward off these pesty insects. He also suggests that coastal property owners make sure they are not inviting mosquitoes into their homes. Repair screen doors and get rid of standing water in gutters, pots, tires and the like, he says.

If you want to bring your dog or cat along to the beach, use repellents on it, too, says Newton. Dogs should be given preventative heartworm medicine and, if possible, be placed in a mosquito-free shelter.



Dave Hill, a Sea Grant seafood technician at the NCSU Seafood Laboratory in Morehead City, spends his time at a drafting table, sketching seafood plants.

He makes line drawings of new plant layouts and expansions of old plants. Lately, Hill has noticed more of his sketches turning into reality.

For example, in 1982 and 1983, 21 companies asked the Seafood Lab for help. Hill supplied them with line drawings of crab plants, oyster shucking houses, freezer plants and retail markets. Of the 21, seven plants are completed and operating with an estimated new employment of 300 people. And, three more plants are under construction. When they are completed, about 130 more jobs will be open.

If you'd like to contact Hill or any of the Sea Grant staff at the Seafood Lab, write NCSU Seafood Laboratory, P.O. Drawer 1137, Morehead City, N.C. 28557, or call 919/726-7341.

*The Effects of Salinity on the Potential of a Blue-Green Algal (Microcystis aeruginosa) Bloom in the Neuse River Estuary, N.C., by Hans W. Paerl, Patricia T. Bland, Jef-*

frey H. Blackwell and N. Dean Bowles, all of the UNC Institute of Marine Sciences, examines the saltwater tolerance for the major bloom-forming nuisance species of blue-green algae in the Neuse River. The study also looks at the algae's ability to survive and proliferate in the marine environment.

For a copy of this working paper, write to UNC Sea Grant. Ask for UNC-SG-WP-84-1. The cost is \$1.25.

Mini-grant funds have been awarded to John Maiolo, an East Carolina University sociologist, to study the social and economic impacts resulting from growth in the North Carolina crab fishery.

This state ranks third on the Atlantic Coast in blue crab production. Pamlico Sound has yielded about 10 million pounds of crabs annually since 1970. And since 1978, North Carolina fishermen have landed record catches of blue crabs.

But the growth of the fishery hasn't been without its problems. Maiolo will analyze the conflicts among fishermen, the competition for space and the effects of changes in stock availability as a result of the growing fishery.



The waterway is crowded. Doves of swimmers ride the waves as big and little boats whiz by them. Who has the right to use this waterway? Everyone.

The laws concerning such rights on North Carolina's waterways are complicated. And the problems may be getting worse with increased coastal development, says Walter Clark, UNC Sea Grant's coastal law specialist.

These laws, or public trust rights, are "the rights that you have as a citizen of the state to use state property," says Clark. This property

*Continued on next page*



includes most of the navigable waters in the state. North Carolina's citizens have the right to use the water for recreational purposes such as boating, skiing and swimming or for commercial purposes such as shrimping or fishing.

Conflicts arise with public trust rights because more people want to exercise their rights on the waters, says Clark. For example, a commercial fisherman who has set a net in a waterway may be interfering with someone's boating or skiing.

If you are involved in such a conflict or would like to know more about public trust rights, write Clark at UNC Sea Grant, Box 8605, NCSU, Raleigh, N.C. 27695-8605. Or call 919/737-2454.



The future of marine and aquatic science may be in good hands, thanks to teachers who supervised students participating in the 1984 "World of Water" competition. The competition, sponsored by the National Marine Education Association, awards 20 students for science projects focusing on marine affairs. "World of Water" is designed to promote the career potential in marine and aquatic fields.

Lundie Spence, UNC Sea Grant's education specialist, and Dr. Jack Wheatley of the Division of Science Education at North Carolina State University, have received a grant from

the National Science Foundation to recognize these educators. Wheatley also will study the methods the teachers used to influence students' attitudes toward research projects.

As part of the recognition activities, the teachers will participate in the National Youth Conference on Marine and Aquatic Science in Washington, D.C., September 10 and 11. They also will attend Oceans '84, a major oceanographic conference also being held in the nation's capital.

Spence hopes that teachers attending these conferences will learn about new trends in marine science and take them back to their classrooms.

Soft shell crabbing can be profitable. But some soft shell crabbers have experienced high mortality rates among the crabs in their holding tanks, cutting down on their profits. Some researchers thought the crabs died because of microbial infections caused by improper handling or poor water quality in the holding tanks.

But Robert Sizemore, a biologist at the University of North Carolina at Wilmington, has some different ideas. Using UNC Sea Grant mini-grant funds, Sizemore will study "peeler" crabs. He thinks that crab mortality may be caused by a bacteria that exists in normal healthy crabs. But when the crabs are stressed under holding conditions, the bacteria may develop into acute infections that cause death.

If Sizemore's predictions prove correct, he may be able to develop techniques that will minimize crab mortality.

Jeff Johnson, an anthropologist at ECU's Institute for Coastal and Marine Resources, received a mini-grant to study the movement of commercial fishermen and vessels among Atlantic coastal states. Michael Orbach, also of ECU, will assist Johnson on the project.

Whether they're fishing for scallops, shrimp, bluefish or mackerel, North Carolina fishermen are sure to go where the catch is best. Johnson and Orbach will study the migratory patterns of fishermen along the Atlantic coast, the interdependence that migration creates among coastal states, and the implications for fishery management and policy.

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## COASTWATCH

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# COAST WATCH

Photo by Joel Arrington



Photo from NCSU Agricultural Communications



*Fishermen say runoff from farm fields may be affecting their catches*

## Water: a question of use

Like his father and grandfather before him, Dell Meekins fishes the waters of Pamlico Sound near Engelhard. He catches mostly croaker, but these days he doesn't always reach the dock with a full hold.

"Every year, there are less and less fish and smaller and smaller fish," says Meekins, a member of the Governor's Coastal Water Management Task Force. "Three or four years ago, we were catching as many large croaker as medium and small. But this year, I haven't even seen what I'd classify as a

large croaker." (Meekins classifies a 3-pound croaker as large.)

To make matters worse, the smaller croaker bring a lower price in the market. Meekins says, "One time I had to quit working because they were so small."

Meekins isn't a biologist. But he knows that croaker and other commercially important species are dependent on the estuaries—estuaries he says are declining in quality. He thinks one of the culprits may be freshwater

*Continued on next page*



drainage from nearby farm fields. But he adds that it's not the only culprit.

Meekins scoffs at a view that portrays him and his fellow fishermen at odds with the farmers. Both realize there is a problem, he says. But he adds that it's going to take time and research before the finger, or fingers, of blame can be pointed.

"The fisheries are declining and we're passing the buck onto somebody else. Agriculture is part of it, but not all of it," says Meekins.

Meekins attributes some of his empty hauls to increased fishing pressure. "Twenty years ago we had 55-foot boats in Pamlico Sound. Now,

*Photo by Nancy Davis*



*Uli Bennewitz*

that's a small trawler. We're capable of catching so much more these days. We can't put all the blame on the farmers."

**A**dd to that an increase in the number of fishermen, both recreational and commercial, says Meekins. While the statewide catches may be up, the catch must be divided among more fishermen.

Stumpy Point fisherman Fran Altman agrees with Meekins. "There are so many more boats and more people fishing now. The slice of the pie has just gotten smaller," says Altman, also a member of the Governor's Coastal Water Management Task Force.

While Altman says land drainage is probably not the only cause for his

smaller catches, he does think it's a contributing factor. "It has to be affecting our fishing, but it's certainly not the only villain."

Meekins says he'd like to see stricter controls and regulations placed on the fishing industry and more research to see if the theory of freshwater drainage is founded. He thinks that the drainage affects the estuary during the crucial spring months when juvenile fish and shellfish arrive after spawning offshore.

**F**armers are concerned about the drainage problem, too. But their livelihoods depend on their ability to control the water. Without ditches and canals, a heavy rainfall would flood their fields, destroying their crops.

Uli Bennewitz manages Lux Farms—9,000 acres of corn, soybeans and forest near Engelhard. He explains the dilemma: "In theory, we're at sea level. If it doesn't rain at all, we don't have to pump. But every time it rains, we have to pump. We're in a constant juggling situation, trying to compromise with the water table. In the summer, we try to raise the water table. In the winter and spring, we pump more to lower the water table."

**B**ennewitz is also manager of Mattamuskeet Drainage Association. The six-member, 40,000-acre drainage district is composed of six pumping stations. Three drain into the Intracoastal Waterway, one into a barge canal and two into the environmentally-sensitive Pamlico Sound. Bennewitz says 80 percent of the runoff is funneled into the Intracoastal Waterway, which is not considered to be environmentally sensitive.

"We're doing as much as possible to minimize the pumping on the east side (near Pamlico Sound)," says Bennewitz. "We have double the pump hours on the west side as on the east side."

Bennewitz looks at both sides of the drainage issue. He says there's no evidence that farm drainage is affecting the production of the estuaries. But he adds that there's no evidence that it's not affecting it either.

Until scientists find some answers, Bennewitz has some ideas he thinks may help. He'd like to pump some of the excess water into agriculturally non-usable land, dike it and create a lake. Then, when the hot summer

months bring on a drought, he could recycle the water by irrigating his crops with it. Bennewitz says he'll have to convince the U.S. Army Corps of Engineers to go along with his plan before he can implement it.

UNC Sea Grant Director B.J. Copeland says the estuaries are affected by a variety of factors. "The estuaries are located at the end of rivers and whatever goes on upstream in the Piedmont affects them," says Copeland.

Belhaven farmer Marion Dilday takes a tougher approach. "All the water from Raleigh finds its way into the creeks, rivers and sounds. It's not

*Photo by Nancy Davis*



*Dell Meekins*

only farmland that drains. I think there's probably more pollution from up above than from down below," he says.

But for Dell Meekins and Fran Altman, empty nets mean lean years. They hope researchers will find some answers—and soon. But even answers won't cure the ills plaguing the fisheries, says Meekins. "It took years for this to happen and it's going to take a lot of years to cure it."

—Nancy Davis



## Fishing for answers

# Where land and sea meet

In eastern Hyde County, some of the state's most productive land lies adjacent to some of its most productive coastal water. But the distinction between the two is vague; much of the land is barely above sea level.

Farmers have found that these drained wetlands yield bountiful crops—if they can control the water. Ditches drain the fields, and canals carry the runoff to creeks that empty their waters into Pamlico and Albemarle sounds.

Experts tell us more than 2 million acres in coastal North Carolina are being drained. And the water from those fields ultimately reaches the estuaries that serve as nursery grounds for over 90 percent of the state's commercially important fish and shellfish.

Scientists, resource managers and fishermen are worried that the freshwater influx may be affecting the makeup of the estuaries and in turn affecting fisheries production.

In 1981, the Governor's Coastal Water Management Task Force was formed to make recommendations for improved water management. Recently, the N.C. General Assembly acted on those recommendations, appropriating money for a study to measure the impact of land drainage on estuaries. Researchers will use Broad Creek in Hyde County as a demonstration site.

UNC Sea Grant Director B.J. Copeland, coordinator of the project, says the goal is to demonstrate the relationship between an estuarine nursery and water management.

Sea Grant researchers John Miller, Margery Overton and John Fisher will participate in the project. In an earlier Sea Grant project, Miller studied the effects of salinity changes on juvenile fish and shellfish, using Rose Bay as his laboratory. A heavy rainstorm meant a drop in the bay's salinity. Then, he waited for Mother Nature to perform experiments for him. When she did, he analyzed the effects.

But Miller says the Broad Creek site offers researchers a chance to do more

than just study the effects of a heavy rainstorm on estuarine organisms. They'll be able to "create" their own rainstorms.

The flow of runoff into Broad Creek is controlled by a pumping station on the 5th Avenue Canal. (The canals are so numerous that they've been given the names of avenues and streets.) With the help of landowners, researchers will manipulate the amount of water entering the nearby estuary. Scientists will use one branch of the creek as a control while they perform experiments on the other branch.

"This project presents an opportunity to get answers much more efficiently," says Miller. "We'll be able to discharge significant amounts of fresh water into an estuarine area. And hopefully we'll be able to see the impact on the biology of systems and how fast they recover."

Miller has some theories about what he may find at the Broad Creek site. In his research on Rose Bay, he found

that up to a certain point, a salinity reduction did not produce much change. But further decreases in the salinity resulted in what Miller refers to as "thresholds."

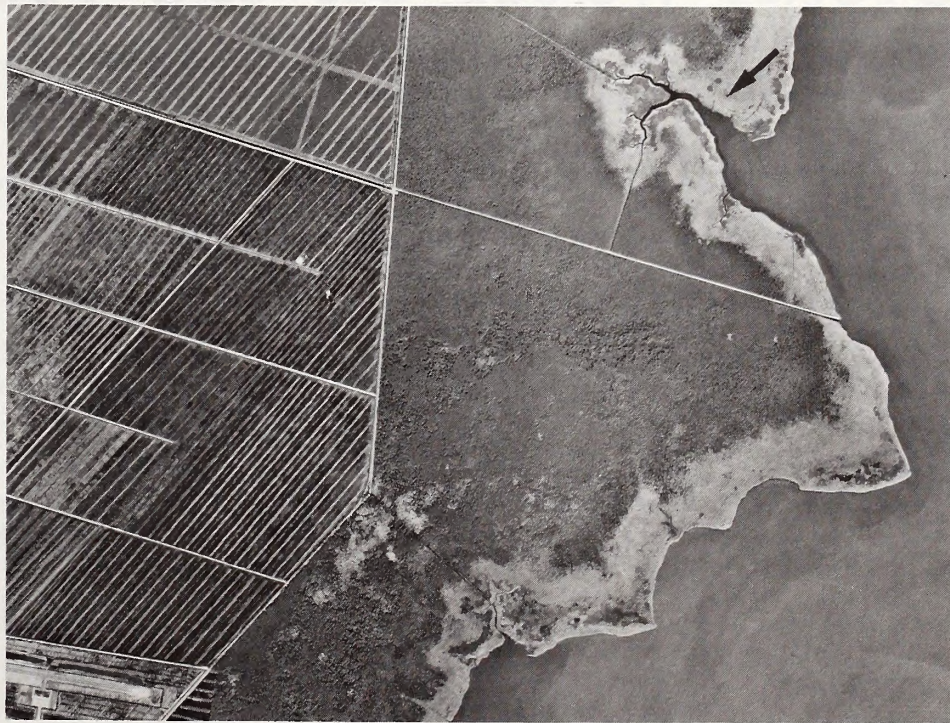
At the first threshold, the estuary undergoes a temporary change in the distribution of fish and shellfish. At the second threshold, the change may be great enough to force baby fish into areas of higher salinity where they would be vulnerable to predation.

At the third threshold, the fish population could experience permanent reduction, says Miller. The change in salinity might be great enough to cause the death of the fish's food supply or of the fish themselves.

Miller will be testing the waters of Broad Creek to find out if his theories hold true. He says his strategy will be to determine what those thresholds are. He may begin by reducing the salinity by 50 percent in one day. Or, perhaps he will reduce the salinity by

*Continued on next page*

*Photo from USDA Agricultural Stabilization and Conservation Service*



*Fields, ditches and canals near Broad Creek (see arrow)*



25 percent for two days. Then he'll measure the response of the fish and shellfish.

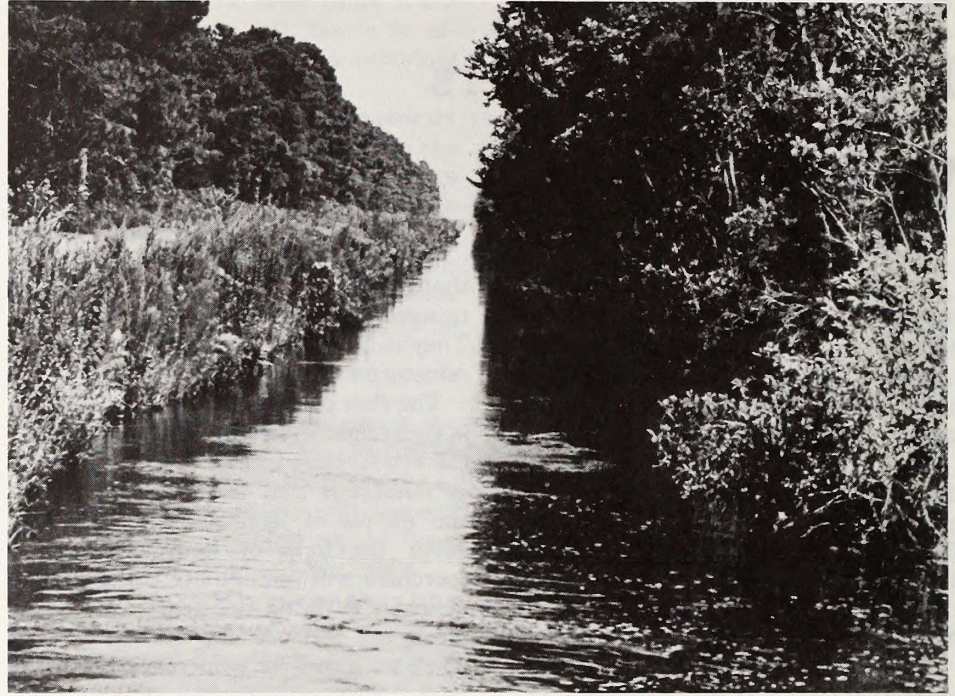
He'll also study how long it takes the system to return to its original state. It may be that some species can handle the fluctuating salinities better than others.

Sea Grant researchers Overton and Fisher will attack the freshwater drainage problem from an engineering angle. They'll measure how much water flows into the creek and record depth, temperature and salinity data. In a second phase of their project, they'll develop a mathematical computer model to simulate the flow of fresh water into the estuary.

Also participating in the three-year project are the N.C. Division of Soil and Water Conservation, the N.C. Division of Environmental Management, and the N.C. Division of Marine Fisheries.

Sea Grant estuarine research will complement the state-supported Broad Creek project. Researchers will probe the relationships between predator and prey in the estuary. They'll examine the food sources for the commercially important spot and

Photo by Nancy Davis



*5th Avenue Canal carries water from ditches to the sound*

croaker. Wayne Skaggs and Wendell Gilliam will develop a model to predict the effect of different drainage methods on the flow of water from the fields. In his Sea Grant-supported pro-

ject, Miller will investigate the recruitment of juveniles to their nursery areas and the resulting variation in juvenile abundance and production.

—Nancy Davis

## Clean water on tap for N.C.

A lone boater putters across the Chowan River at dusk, heading for the dock. With the sun and trees behind him, everything appears postcard-perfect. But a closer look tells us something is muddling the picture—and the water.

Pollutants, sediments and toxics flow into the Chowan and other North Carolina waterways every day. And the situation may be getting worse with increased construction and industrial development.

Yet many state officials and citizens believe something can be done to clean up our water. Several water projects have already been initiated, and the N.C. General Assembly recently appropriated nearly \$7 million for the Clean Water Budget of the N.C. Department of Natural Resources and Community Development.

This legislation, which has been on tap for two years, provides funding for research and assistance programs across North Carolina. A synopsis of the projects follows, with emphasis on those relating to the coast.

### Coastal Water Management Program

It's no secret to the individual coastal fisherman that the catches just aren't as big as they used to be. No one is sure what the cause is, but some speculate it may be a result of

freshwater drainage into the brackish estuaries.

To find some answers, the legislature appropriated funds for research at Broad Creek in Hyde County. Three state government agencies, in cooperation with Sea Grant researchers, will study the effects of land drainage into the estuaries.

Anne Taylor, NRCD's deputy assistant secretary for natural resources, sees this project as one in which the state, farmers and fishermen can all work together.

"The result of the Broad Creek demonstration project should be the guidelines under which farming and forest operations along the coast are managed in harmony with the fishing industry," she says. "The significance of those funds to do that research project should have long-term ramifications."

Money also was appropriated to the Division of Soil and Water Conservation for a wetlands identification and mapping project in the Albemarle and Pamlico sounds area.

### Nutrient Sensitive Watershed Project

A little greenery growing in our rivers and streams is all right, but not if it becomes harmful. Bacteria and vegetation sprout when nutrients like phosphate and nitrogen seep



into the water from industries, farms, city streets, forestland and even the air.

Three bodies of water, the Chowan River and Jordan and Falls lakes, are especially susceptible to this type of growth and are legally designated as "nutrient sensitive." Already, the Chowan River and lower Neuse River contain nuisance blue-green algal blooms that were facilitated by these nutrients. UNC Sea Grant researcher Hans Paerl has found that these blooms may be altering the food chain.

With such problems evident, the legislature earmarked approximately \$3 million to the study of these watersheds, or drainage areas. Two-thirds of the money will go to NRCD's Division of Soil and Water Conservation to provide cost-sharing programs to farmers in 15 surrounding counties, says Buddy Atkins, chief of the division's Agricultural Non-Point Source Section.

Under these programs, farmers receive state funds for implementing "Best Management Practices" to reduce the flow of animal wastes, fertilizers, pesticides and other pollutants into the waterways. BMPs include such techniques as waste management systems, conservation tillage, terracing, planting grass waterways, strip-cropping and crop rotation.

The BMP program, scheduled to begin in September, will be administered by the local Soil and Water Conservation districts. Similar federal cost-sharing programs are currently offered and can be used in conjunction with the new state program, Atkins says.

Farmers aren't the only ones who will be using BMPs. Loggers will be also. Cutting down trees, making roads and clearing land should be regulated because each contributes to erosion on the coast and inland, says H.J. "Boe" Green, director of the Division of Forest Resources.

"Soil sediment is considered to be the greatest water pollutant we have," Green says. "Depending on the amount of sedimentation, it causes the water to be unfit to use. . . It carries nutrients into the water and contributes to algal problems," and is harmful to fish when it settles in the reser-

voirs. We already see these problems in the Chowan and Neuse rivers, he says.

A large portion of the funds will be used to minimize erosion. Loggers will be asked to make proper stream crossings and road layouts, to seed roads with grasses quickly after logging, and to plow only surface soils. Other monies will go toward seed, fertilizer and labor for revegetating cleared land.

To help identify highly erodible lands around the Falls-Jordan area, some state government computer whizzes have developed a map that won't be found in any gas station. The Land Resources Information Service, under NRCD's Division of Land Resources, mapped the Falls Lake area and received funds to compile a similar one for the Jordan watershed.

The maps show a variety of information that can be color-coded and presented in overlays, says Karen Siderelis,

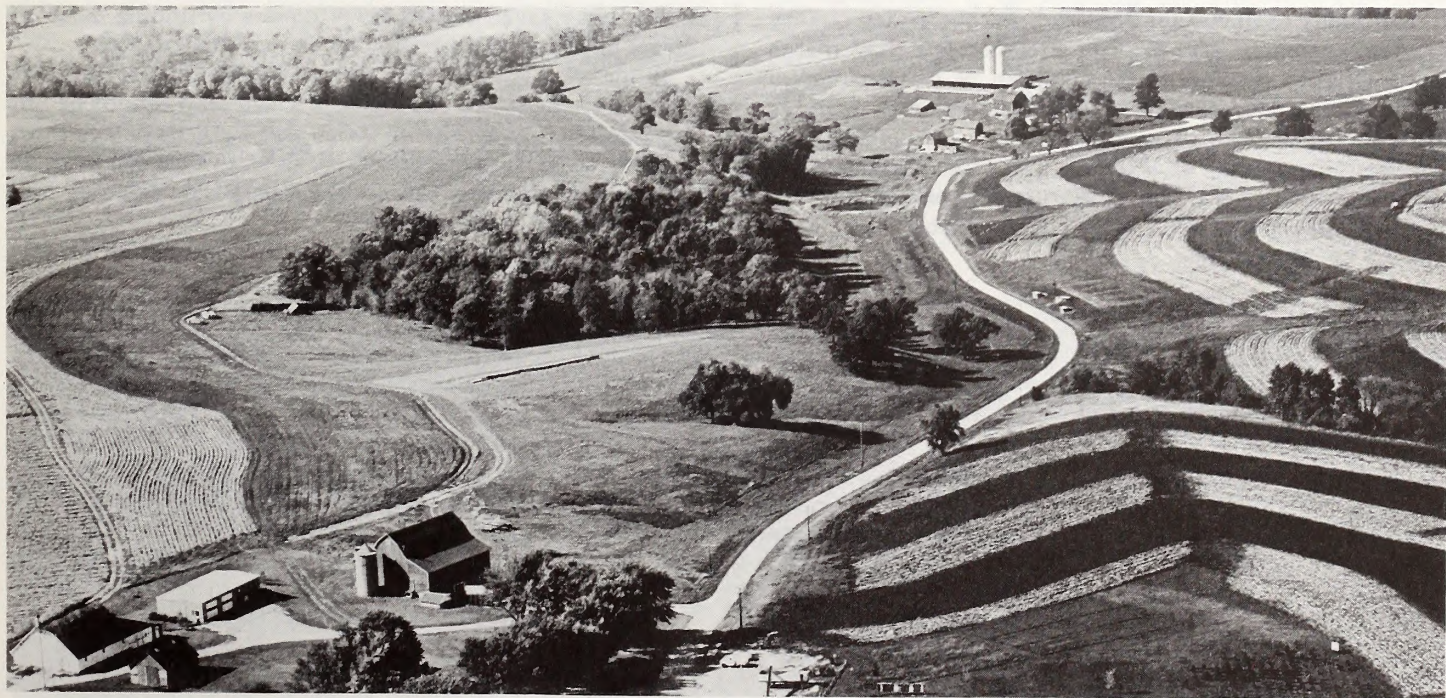
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*Photo by Herman Lankford*



*Use of forestry BMPs will cut down on erosion*

*Photo from NCSU Agricultural Communications*



*Strip-cropping and grass waterways are effective deterrents to land drainage*



director of the service. Each shows base-map data such as roads, streams, urban areas and counties, plus other data on erosion rates, drainage and conservation areas, land use and soil depths.

Matching these factors helps pinpoint areas likely to erode, says Bill Holman, a lobbyist for the Conservation Council of North Carolina. Mapping is important not only to scientists and farmers, but also the policymaker judging which areas need attention, and to developers considering sites for construction.

And right now, "There's so much construction in this area it just overwhelms you," says Steve Conrad, director of the Division of Land Resources. Part of his job is to see that builders use an approved erosion control plan when constructing. But since this was made a law in 1973, some builders have complied and some haven't, says Conrad. For this reason, \$158,000 were budgeted for the division to improve monitoring of construction sites in the three watershed areas.

*Photo by Jim Page*



#### *Budget calls for improved planning of development*

Monitoring of a different kind will be taking place in the Chowan, Jordan and Falls. The Clean Water Budget included about \$350,000 for the study of the water quality standards of each, says W. Lee Fleming Jr., chief of the Water Quality Section of the Division of Environmental Management. Researchers will sample and analyze nutrients taken from these areas.

A major concern of Fleming's is the regulation of phosphates. He says if the legislature had passed the controversial phosphate ban, the problem would have been reduced by 25 percent.

But the municipal discharges of phosphate are just part of the problem. "We still need to know how many nutrients are going into the rivers and who's contributing what. You want to be fair in asking different groups to decrease nutrients," says Holman. And to do this, "more information is needed to make better decisions."

### Statewide Toxics Program

In some of North Carolina's waterways, toxics are streaming in from a variety of sources. Researchers aren't sure, however, what these toxics are or where they are originating.

To answer a few of these questions, appropriations will aid Fleming and his staff in setting up extensive screening procedures to test discharges and their toxicity on fish and other organisms in the water. In addition, a mobile lab is taken to different waterways twice a month to test waters all over North Carolina.

### Pollution Prevention Pays Program

In 1983, 7.3 billion pounds of hazardous wastes were generated in North Carolina. The culprits include everyone from chemical companies to homeowners.

To help prevent our state from becoming a large wasteland, the state initiated the PPP program, patterned after one used by the 3M Corporation. According to the program's director, Roger Schecter, it is "a way of looking at or reducing pollution and/or toxics before they become a problem."

Schecter and his staff, in conjunction with other state agencies, work on an individual basis with each client to determine what types of pollutants the companies discharge and to suggest ways to reduce, prevent, recycle or eliminate those materials before they reach the air or water.

And it's paying off, says Schecter. Companies such as Burlington Industries, Burroughs Wellcome and Duke Power have saved thousands of dollars by finding more efficient methods of disposing of or recycling wastes.

While elements of the Clean Water Budget are not specific to the coast, the benefits it will reap cannot be underestimated, says Taylor. With the waterways upstream and the coast downstream, there have to be some positive effects. But, she says, this budget is only the beginning step to cleaning up our state's waters.

—Sarah Friday

## More troubled waters

Researchers know that problems exist in the waters near the coast. And the answers to those problems are often as muddy as the waters themselves. There's a new project in the making, though, that may be able to clean up them both.

In the past few years, there have been several state, federal and local studies focusing on the Pamlico and Albemarle sounds and the waters surrounding them. As a result, the scientists who looked at subjects like fishing

resources, drainage and peat mining have identified some of the most common and pronounced problems.

Now, the N.C. Department of Natural Resources and Community Development is organizing a comprehensive program to find some solutions. Spurred by the action of N.C. Congressman Walter Jones, through his Merchant Marine and Fisheries Committee, to designate Albemarle Sound as an "estuary of concern," the program will be carried out by NRCD, UNC Sea Grant and other governmental agencies. Jim Smith, coordinator of the Coastal Energy Impact Program, says a few of the projects will include studying the changing land uses, substances coming from the rivers and vegetation of the sounds.



# THE BACK PAGE

"The Back Page" is an update on Sea Grant activities — on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454). For copies of publications, write UNC Sea Grant, NCSU, Box 8605, Raleigh, N.C. 27695-8605.



If it's a marlin you want to catch, there's no better place to fish than the Gulf Stream. But first you must find this meandering corridor of warm water that cuts along the East Coast. The Gulf Stream can shift position, alternately snaking and straightening as it flows northward. Often eddies of warm water break off the main body of the stream.

Commercial and recreational fishermen seek out the Gulf Stream and its eddies because of the warm-water fish that travel its path. Marlin, tuna, wahoo, dolphin, swordfish and shark are prevalent.

Jim Bahen, the Sea Grant marine advisory agent at Ft. Fisher, wants to help fishermen locate the elusive Gulf Stream before they leave the docks. Bahen has worked with the National Environmental Satellite Service in Miami to develop a chart that plots the Gulf Stream's path on a longitude-latitude grid from Jacksonville, Florida to Norfolk, Virginia. The chart also provides the width of the Gulf Stream, the average speed of its axis in knots, its average temperature in Celsius, and the distance from its western wall to landmarks such as Frying Pan Tower. Bahen will receive the chart three times a week via a telecopier at his office. He says the charts can save fishermen time and fuel.

If you'd like to know more about

Bahen's Gulf Stream Information Service, write him at the Marine Resources Center/Ft. Fisher, General Delivery, Kure Beach, N.C. 28449. Or call 919/458-5498.



From Calabash to Currituck, the UNC Sea Grant Marine Advisory Service has news for you—the commercial fisherman, the angler, the aquaculturist, the seafood dealer, the property owner. Marine advisory agents Jim Bahen in Wilmington, Bob Hines in Atlantic Beach, Wayne Wescott in Manteo and Randy Rouse in Aurora have joined with specialist Rich Novak to bring the public an informal monthly newsletter about the latest in commercial and recreational fishing gear, fisheries regulations, fishing tournaments, aquaculture, marketing news, publications and more.

The team is calling its newsletter *The Marine Advisory News*, and it's free for the asking. The team newsletter takes the place of separate newsletters, such as *Light Line*, published by individual agents. To receive a copy, write *The Marine Advisory News*, Box 8605, North Carolina State University, Raleigh, N.C. 27695-8605.



What yields more crabs in a single catch than eight to 10 crab pots? The answer: a peeler pound. Randy Rouse, the marine advisory agent at the Aquaculture Research Center in Aurora, is experimenting with a peeler pound to catch hard crabs and peelers. So far, the results have been good. In one night he caught 50 legal-size crabs, 15 peelers, three flounders and four large eels.

Used frequently in Virginia, peeler pounds are set in shallow water and extend from the shore to a trap at the

end. The peeler pounds have three main parts—the lead, the heart and the trap. Leads are usually constructed of crab pot wire strung along the bottom, but some are made from net webbing. Hearts are generally constructed with wire and may or may not have tops and bottoms. The heart herds the crabs to the trap, which is also constructed of wire and attached to framing made of treated wood or iron.

Rouse learned that peeler pounds need to be set in protected areas where winds and waves can't destroy them. And he's had some problems with grass fouling the lead.

If you're interested in learning more about peeler pounds, write Rouse at the Aquaculture Research Center, Rt. 2, Box 305, Aurora, N.C. 27806 or call 919/322-4054. Rouse suggests that fishermen talk with an N.C. Division of Marine Fisheries enforcement officer about regulations before setting up a peeler pound.



The western Pamlico River isn't a place for females—female blue crabs that is. Researchers have estimated that female blue crabs make up only about nine percent of the total blue crab catch in the area. And this makes for problems when it comes to harvesting peelers. Other crabbers along the coast catch female peeler crabs (mature females ready to shed and mate) by baiting their pots with male crabs called "jim-mies." But in western Pamlico River, the low percentage of female crabs makes this method unprofitable.

Using UNC Sea Grant mini-grant funds, two scientists, Graham Davis and Steve Harlan of East Carolina University, will study alternative methods for harvesting peelers. They plan to add synthetic grass to peeler pots to create a refuge for the soon-to-shed crabs. Studies have shown that peelers seek out grass beds as a haven

*Continued on next page*



of protection when they shed. These grass pots may be a way to entice the mainly male crab population into the pot, and the pot will allow for easy harvest by the fishermen.

*Coastwatch* will report what the scientists find out in a later issue.

If you've ever seen a stranded dolphin or whale on the beach and weren't sure what to do, you may want a copy of a new UNC Sea Grant Blueprint, *Beached Marine Mammals*. It describes steps on handling marine mammals and gives local and regional telephone numbers to call for help.

For a free copy of this Blueprint, write UNC Sea Grant. Ask for publication number UNC-SG-BP-84-2.

If sport fishing is your game, then UNC Sea Grant has two fishing charts that could help you locate prime "fishing holes" before you leave the docks. The first chart shows fishing locations near Masonboro Inlet on one side, and the locations off Beaufort Inlet on the other. The second chart covers the waters around Roanoke Island and those off Oregon Inlet.

Both charts include loran headings and are designed as a navigational aid. They are place mat size and waterproof. For your copy, send \$1 for each chart to UNC Sea Grant. Be sure to specify which chart you're ordering.



Jim Murray, director of UNC Sea Grant's Marine Advisory Service, and Jeff Johnson, an anthropologist at East Carolina University, have received a second year's grant from the National Marine Fisheries Service to develop a program that will increase the demand for underutilized fish among recreational fishermen in the Southeast.

"We will be building on the marketing research that was done in year one," Murray says. "We'll be choosing 10 to 12 species of fish to target for a major educational campaign, fishing tournaments, posters, brochures, radio spots and television programs."

Murray and Johnson will be working closely with Sea Grant's Southeast Marine Advisory Service to develop programs and disseminate information.

Walter Clark has been named to fill a newly created position as UNC Sea Grant's coastal law specialist. Clark, formerly the chief of Implementation and Enforcement at the N.C. Office of Coastal Management, had just completed a temporary one-year appointment with UNC Sea Grant.

Clark holds a law degree from Wake Forest University and a master's degree in regional planning from the

University of North Carolina at Chapel Hill.

If you would like to contact Clark, write him at UNC Sea Grant, Box 8605, North Carolina State University, Raleigh, N.C. 27695-8605 or call 919/737-2454.

UNC Sea Grant Director B.J. Copeland was selected as chairman-elect of the Council of Sea Grant Directors during a July meeting in Minneapolis. He will become chairman in 1985. The Council of Sea Grant Directors works with the Office of Sea Grant to establish national policies for the National Sea Grant Program, develop program directions for the Office of Sea Grant, and unify the 29 state Sea Grant programs into a national program.

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# COASTWATCH

Photo by Joel Arrington



*A hunter has his sights set on an overhead flock*

## Reaping the fall harvest of the coast

The first Americans knew the bounty of the coast. From the sea, they gathered fish and shellfish; from the marshlands and dunes—berries, nuts and other edibles; and from the forests—the meat and skins of wildlife. For our ancestors, fishing, foraging and hunting were matters of survival.

Today it's easier. We gather our meals from the shelves and bins of the supermarket. But there are those who still prefer the taste of wild game, the flavor of mullet roe and the goodness of wild grapes.

This month, *Coastwatch* takes a look at the traditional harvests of the Carolina coast.



# Stalking the backwoods for game

Bob Midgett, an avid hunter for most of his 75 years, doesn't need a scrapbook to remember the old days. Pictures of elegant lodges, hordes of hunters, and birds "so thick you couldn't see through them," remain clear in Midgett's mind. His love of the sport was passed on to him from his father, a market hunter during the heyday of waterfowl hunting on North Carolina's coast.

"I started hunting with my daddy," says Midgett. "It was thrilling. It was something that I had in my blood."

And blood and history run thick in eastern North Carolina—almost as thick as the wildlife. Generations of hunters have kept the traditions alive. Over the years, the equipment has changed, but many of the methods and memories remain the same. Many continue to hunt because "It's part of our rural heritage," says John Collins, big game project director with the North Carolina Wildlife Resources Commission. "Most people that were born and raised on a farm are naturally hunters. They're close to nature."

About 160,000 such sportsmen hunt deer, bear, wild turkey, dove, quail, squirrel, rabbit, waterfowl and other game in the state each year. Most of these species have been pursued for centuries, but other prey either migrated or became extinct. Buffalo and elk, for example, used to roam the coastal plains with the Indians, says Ted Dossett of the Conservation Education Division of WRC. Ivory-billed woodpeckers, Carolina parakeets, passenger pigeons and beavers were plentiful as well.

Since that time, hunting on the east coast has gone through many changes. What was once done out of necessity, as with the Indians, is now almost entirely done for recreation.

The coastal Indians were skillful hunters, relying on their talents with the bow and arrow to feed and clothe themselves. Hunting was vital, and resources were abundant. But because there were no limits, some of the species they hunted slowly died out.

The availability of game lessened

with the arrival of the white man, says Dossett. Anxious to claim lands, they cleared away the forests—and the natural habitats—for settlement. Also, Indians used wildlife as a means of barter. Furs and meat were traded for steel, guns, glass and other goods.

Throughout the 1700s, the bounty of game on the coast continued to fill the pockets of traders and the plates of colonists. For example, 300,000 deerskins were shipped overseas in the 1700s, says Scott Osborne, the deer project director of WRC.

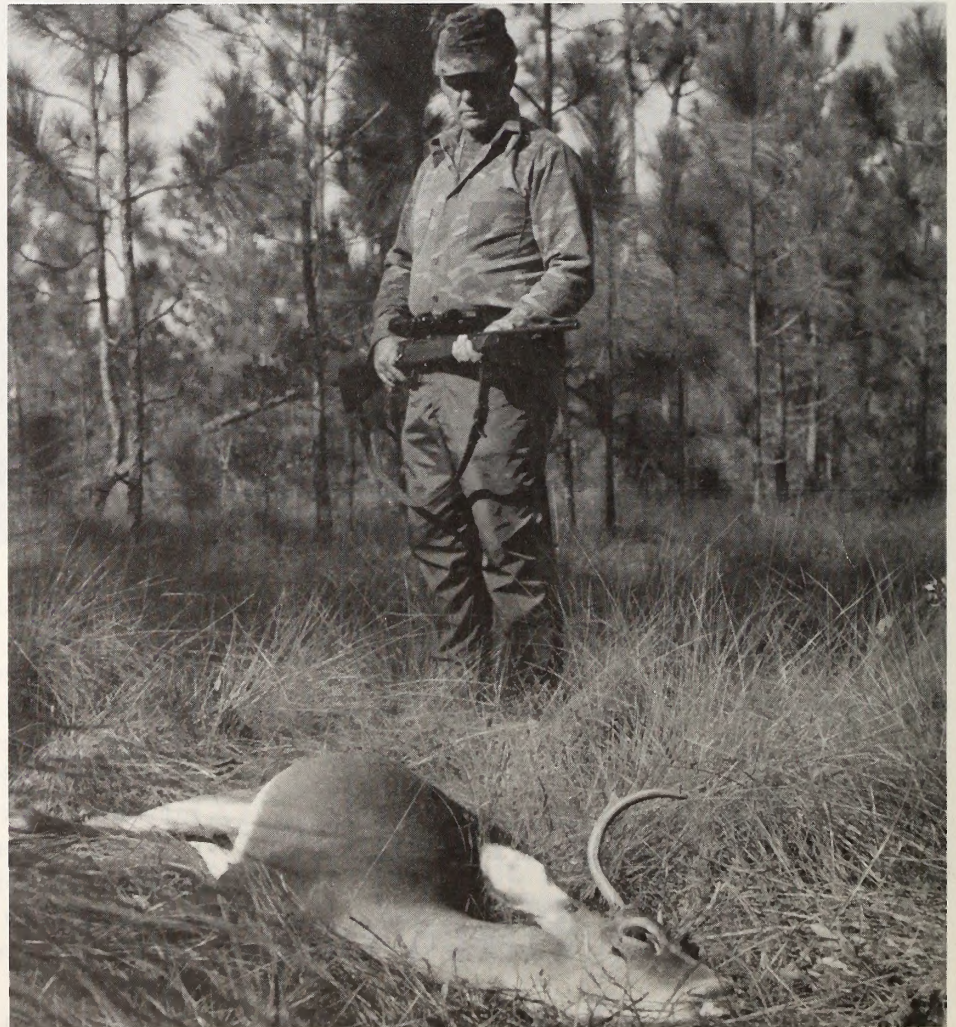
In the 1800s, the ready availability of game, especially deer and waterfowl, prompted market hunting. An absence of laws, bag limits and other shooting

regulations allowed hunters to capture and sell all the wild game they could shoot. What started as a lucrative industry, almost ended in disaster, says Collins.

"Big game were reduced in great numbers by market hunting. Until the early 1900s, there were very few deer in this state because of market hunting and poaching. Bear, deer and turkey were all practically wiped out at some time."

Probably the most famous and glamorous market hunting done on North Carolina's coast was for waterfowl during the late 1800s and early 1900s. Even before then, thousands of ducks and geese flocked to Currituck Sound each winter from the North. In

*Photo from N.C. Wildlife Commission*



*Deer are the state's most hunted game*



1828, the area became more of a hunter's paradise when Currituck Inlet closed. The fresher sound waters allowed wild celery and other waterfowl foods to grow in the marshy areas, attracting hundreds of thousands of birds. It also attracted hunters, like Midgett's father, who could sell their spoils in Northern markets.

During the heyday, there were no hunting seasons, says Midgett. "When the ducks began to migrate from Canada to North Carolina, that's when the season started."

The geese and ducks were shipped in barrels out of Stumpy Point by train to New York and Baltimore. "I heard my daddy say that the most he ever shipped was 16 sugar barrels of geese," says Midgett. In each barrel, 16 geese were stacked around a stovepipe filled with ice shavings and salt. Each goose was worth about \$1.

Jerry Wright of Currituck heard the tales, too, because his grandfather and uncles were also market hunters. He remembers hearing one story in which two gentlemen shot 700 redhead ducks in one afternoon.

Accounts like this spurred wealthy hunters from the North to visit North Carolina's coast. To accommodate them, the natives built stately hunting lodges and started large clubs. Dews Island Hunting Club in Currituck, which opened its doors in 1852, currently is operated by Wright's father. Like other lodges, the club entertained, fed and helped guide the Yankee sportsmen.

In the 1920s and 1930s, increased concern about depletion of waterfowl led to the enactment of several laws, rules and regulations for hunting. The government set seasons and bag limits for waterfowl and other game, and took measures to enforce them.

When the market closed, most market hunters became guides for visiting hunters. Serving as guides is a tradition the Midgetts and Wrights continue.

Today, waterfowl such as Canada geese, snow geese, blue geese, tundra swans, wood ducks, mallards, pigeons, pintails and canvasbacks are plentiful on the coast, says Dennis Luszc, waterfowl project leader with WRC.

However, "Duck populations are lower, in general, compared to what was here in the 1900s, because of a loss of habitats—here and in Canada where a lot of the birds are nesting." To help preserve natural areas for waterfowl, WRC manages about 3,000 acres of impoundments.

The history of big game hunting on the coast is a running list of fluctuations in populations.

Deer populations almost were depleted in the 1920s and 1930s, when only about 5,000 to 10,000 roamed the state, says Mike Corcoran, vice president of the N.C. Wildlife Federation. But with new laws and increased management, the deer populations rebounded. Now 300,000 to 400,000 stalk the forest, making them the state's largest harvest. The number of deer grew so rapidly, that the commission extended the season and allowed hunting for doe.

Bears, on the other hand, "are a funny story," says Corcoran. "They need a lot of room to breed." Bears need three different types of territories—foraging, denning and escape. With increased construction, roads, land clearing and development, the bear population has been broken almost in half in North Carolina. They either live in the mountains or along the coast. Fortunately, the bear population is up from its minimum of 30 years ago.

Similar patterns have been seen with small game in North Carolina. Small game are byproducts of farming. But in recent years, changes in agricultural practices such as mowing of ditch banks, land clearing and use of herbicides and pesticides have caused a decline in such species as the gray squirrel, quail and rabbit.

As long as there are economic pressures to build, it will be necessary to preserve satisfactory wildlife habitats, says Dossett. Because hidden in the backwoods of North Carolina's coast are hunting traditions to continue ... and pictures to add to the scrapbook.

Photo from N.C. Division of Archives and History



Before restrictions, hunters bagged large quantities of waterfowl

—Sarah Friday



# Guide to eating out at the coast

Sit down to a meal gathered from nature—coquina clam chowder, yucca flower fritters, beach peas, steamed periwinkles, cattail pollen bread spread with prickly pear cactus jam, and yaupon tea.

The main ingredients for this menu aren't likely to be found canned or packaged along the aisles of a supermarket. Instead, to obtain the fixings for this meal, you will have to pick, pull, cut and dig your ingredients.

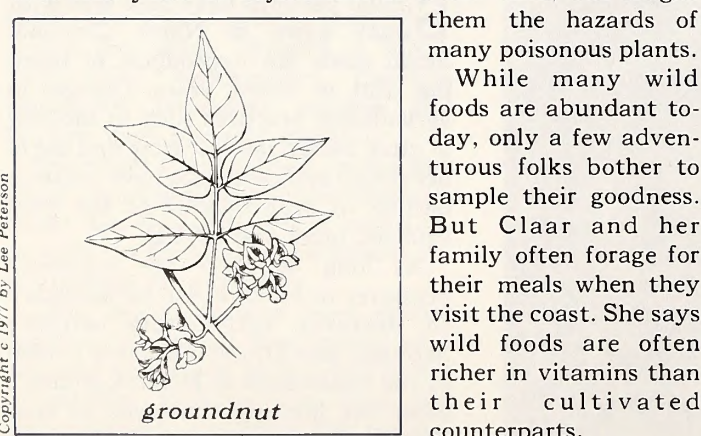
An abundance of plant and animal life is free for the harvest along North Carolina's shorelines, marshes and woodlands. Some items of bounty, such as oysters, persimmons, wild grapes and yaupon, have marked the diets of coastal residents since the Indians. Others have had a more recent discovery.

David Phelps, an anthropologist at East Carolina University, says the Algonkian Indians, native to northeastern



sea lettuce

North Carolina, cultivated many of their plant foods—corn, beans, squash, pumpkins, gourds, tobacco and sunflower. But they also supplemented these foodstuffs with wild fruits, nuts, berries and plants. They made flour from ground acorns and puddings from persimmons.



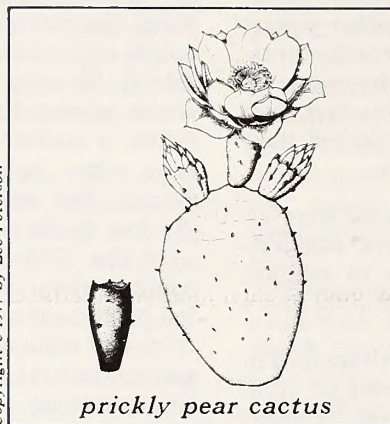
groundnut

The Pilgrims subsisted their first winter in America on the starchy tubers of the groundnut, which grows wild on stream banks along the East Coast. The Indians taught the Pilgrims to eat this tuber. And those who know its goodness still seek the groundnut today, using it like a potato. Maxine Claar, a wild foods expert, says the Indians saved many settlers' lives by teaching them which North American plants were edible. The Indians not only provided information that allowed the settlers to supplement their meals during those first lean years of adjustment to a new land, but taught them the hazards of many poisonous plants.

While many wild foods are abundant today, only a few adventurous folks bother to sample their goodness. But Claar and her family often forage for their meals when they visit the coast. She says wild foods are often richer in vitamins than their cultivated counterparts.

From the surf, the Claars gather coquina clams or mole crabs for broth or chowder. Along the surf and sound edge, Claar collects sea lettuce that has washed ashore to make

another coastal chowder. "I take it home, wash it in fresh water and dry it in a slow oven or outside on a hot day," she says. "Then it becomes dry and crispy. I add it to a milk-based chowder along with butter and wild onions. It makes an excellent chowder."



prickly pear cactus

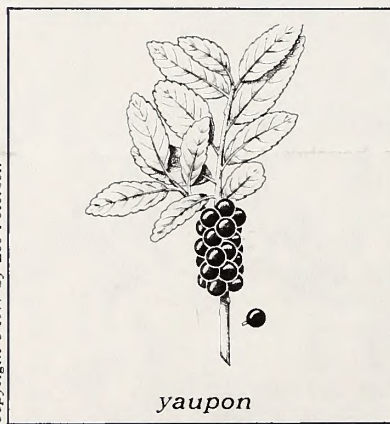
Copyright c 1977 by Lee Peterson

And while the dunes appear barren, they too offer edibles for the forager, says Mark Joyner, the aquariums specialist for the N.C. Office of Marine Affairs. The succulent leaves of the sea rocket, which has a mild mustard flavor, can be steamed or added raw to salads, Joyner says. The trailing wild bean, available from

early September to mid-October, should be picked when it's small and cooked like green beans, Claar says. And the beach pea, which resembles the garden variety, should be chosen when it's tender and bright green for preparation like its domestic relative.

For a more versatile dune plant, seek out the yucca, more properly called the Spanish bayonet. The sweet, white cluster of flowers can be added raw to salads or dipped in an egg batter and fried as fritters, Joyner says. Or foragers can wait until fall when the yucca produces a purplish fruit that can be split, seeded, buttered and baked.

And if you can beat the raccoons and rabbits to the ground cherries, you can stir their sweet red fruit into jams, jellies, toppings or pies. But Joyner warns that unripened,



yaupon

Copyright c 1977 by Lee Peterson

green berries are poisonous.

Other fruits and berries, abundant behind the dunes, make tempting morsels for the sweet tooth. Persimmons and cranberries have been stirred into confections for centuries. Wild grapes, such as fox grapes and pigeon grapes, can be squeezed into juices or seeded for pies and jams. And the fruit of prickly pear cactus, stripped of its bristles, can be eaten raw or cooked into jam.

From the marsh, Claar gathers two wild foods flavored with tradition—marsh periwinkle snails and glasswort. During the days of Charles Dickens, the European species of the periwinkle were roasted and sold on the streets of London and in small restaurants called "winkle shops."

Today, Claar wades through the marsh to pick a similar species, the southern white periwinkle, from the blades of the salt marsh cord grass. She steams the gastropods and



serves them as hors d'oeuvres. The meat should be picked out with a bent safety pin or nutpick and dipped into melted butter or cocktail sauce, she says.

From the marsh edge, Claar chooses the tender, jointed stems of the glasswort for pickles or as a condiment for a salad. Glasswort was a very popular herb among the early colonists, especially Martha Washington.

The wax myrtle, or bayberry shrub, was another coastal plant popular during colonial times. The berries from this shrub were boiled in water to remove their waxy covering for aromatic candles. And the bayberry leaves, as well as leaves from another shrub called the red bay, seasoned stews, soups and chowders, Claar says. And coastal residents today swear by the red bay and bayberry's abilities to ward off insects and fleas.

When it comes to quenching a thirst, drink a glass of iced yaupon tea and sumac lemonade. Yaupon tree roots were steeped to make a black tea that the Algonkian Indians used as a ceremonial purgative. But the colonists found the leaves made a milder brew void of such nauseating effects. Yaupon tea has enjoyed extensive use by coastal residents since colonial days, and many folks drink it today.

The red berries of the summac (not to be confused with ivory-white berries of poison summac) can be crushed and soaked in cold water to make a pink lemonade. But Joyner says the berries should be picked before winter, when heavy rains wash away the tannic acid that flavors them.

Along swampy freshwater areas of coastal North Carolina, Joyner says you can find the most versatile plant in North

America—the cattail. In the winter, the cattail's starchy tubers can be used like potatoes. In the spring the young shoots can be peeled and eaten raw or cooked. The immature flower spikes can be boiled and eaten like corn on the cob. Or you can wait until the spikes have matured and produced a bright yellow pollen that can be harvested and used for flour. When the spike explodes in the late summer, the white fluff can be gathered for use like goose down. Joyner says many of the life jackets used in World War II were filled with cattail fluff.

Before eating any wild plant, berry, nut or fruit, Claar and Joyner stress that it should be positively identified. Many plants are edible, but others are poisonous. Use a good field guide, such as *A Field Guide to Edible Wild Plants of North and Central America* by Lee Peterson, Claar says.

And don't collect your edibles from roadsides, Joyner warns. Roadsides are frequently sprayed with weed killers. And the pollutants from automobiles can contaminate nearby vegetation, he says.

Claar asks that foragers "do not overstrip any area of its vegetation. Pick only what you need."

To learn more about foraging coastal areas, contact the N.C. Marine Resources Centers at Ft. Fisher (919/458-8257), Bogue Banks (919/247-4003), Roanoke Island (919/473-3493), or the N.C. Maritime Museum in Beaufort (919/728-7317). The education specialists at the centers and museum plan foraging expeditions during the spring, summer and fall.

—Kathy Hart

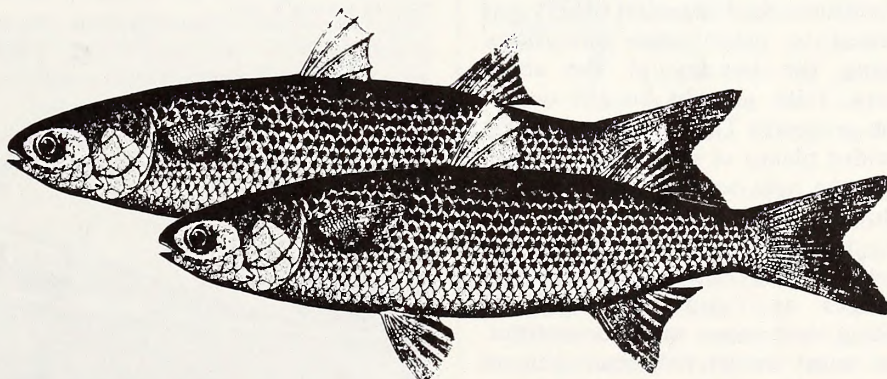
## Mullet runs: a signal in the wind

A hard northeaster' blows across the waters of Pamlico Sound. The air cools, the water temperature drops, and the mullet start to run.

Natives call the winds a mullet blow. In the old days, the fall northeasters were a signal to fishermen—they loaded nets into boats and flocked to the beaches to harvest one of the state's most important cash crops.

But those times are gone. Each year, fewer fishermen watch for that change in the wind, the drop of the thermometer and the black ripple of a school of mullet cutting through the water. On restaurant menus, the mullet has gone out of style. In its place, the flounder, the shrimp and the scallop command a higher price and greater demand.

The state's mullet-fishing tradition isn't lost. Some still watch for the signs of a mullet run, and many more claim mullet is the best fish you'll ever taste. Norwood Frost, a 41-year-old fisherman, has been catching mullet since he was old enough to walk. He's from



Salter Path, a beach town that some claim originally was settled by mullet fishermen. That wouldn't surprise Frost. He says Salter Path is the "paradise of the world." The mullet fishing is pretty good, too, he adds.

Frost looks for the mullet to run around the first of September. But his crew is alone on the beachfront. "We're the only crew left now," he says. "Back yonder, there used to be seven or eight crews. The older guys have died out and the younger ones won't mess with mullet."

Billy Smith, a 55-year-old fisherman

from Atlantic, has been catching mullet for over 35 years. He says commercial fishermen have lost interest in mullet because there's no financial incentive. "Back then, mullet was worth as much as flounder. Now, you get \$1 a pound for flounder and 10 cents a pound for mullet . . . if you're lucky."

Smith isn't likely to sell his nets, though. "It's something I was brought up doing," he says.

Frost and Smith are among the faithful who cling to the tradition of mullet fishing—a tradition that began

*Continued on next page*



with the first settlers. By the 1800s, mullet was one of the main cash crops for the Outer Banks, says Judie Spitsbergen, curator of education at the N.C. Maritime Museum in Beaufort. "Mullet was infinitely important as a source of food. And eventually with the market in other states, it was an important commercial crop," says Spitsbergen.

Outer Banks fishermen were especially known for mullet fishing. During the fall runs, they set up temporary camps made of small thatched huts near the beach. Lookouts kept watch on the waters for the dark mass that indicated a large school.

With one end of a seine on the beach, part of the crew would row into the surf, positioning the other end of the net in front of the approaching fish. As the mullet filled the net, the boat slowly circled toward shore. After making the catch, the Bankers would clean, salt and pack the mullet in barrels for shipment to inland markets.

Over a hundred years later, the method of fishing for mullet hasn't changed. And even the technology has improved only slightly. "We used to row out with the net until outboards came out, and then we got lazy," says Frost. For muscle power to pull in the thousands of pounds of mullet, his crew uses two tractors.

Traditionally, the mullet fishery was confined to beach seine operations. During the heyday of the shore fishery, folks eagerly bought oceanfront property. This prime real estate provided plenty of shorefront for pulling in the nets, says Spitsbergen.

But the beach fishery has seen hard times in recent years. Fishermen like Frost at Salter Path are finding that cottages and condominiums are limiting their access to the oceanfront. Now, most mullet fishermen gill net for the fish in the sounds and inlets.

Two species of mullet inhabit North Carolina waters: the striped or jumping mullet and the white mullet. The two usually are marketed as the same species, and their differences are nearly indistinguishable even to fishermen.

As far as Tate Faircloth is concerned, there's only one kind of mullet—the "pop-eye mullet." That's what he calls jumping mullet because of their "great big old eyes."

Faircloth is a Wrightsville Beach fisherman who has been catching mullet for over 30 years. He fishes the

causeway where regular "mullet stands" along the shore provide areas cleared of debris. "You can't throw one of those big nets just anywhere," says Faircloth.

Fishing for mullet is a lot of work and even more waiting, says Faircloth. "I've set out many a time and never seen a mullet in the water. This time of year, you might see them at any time, but you're liable to sit there all day long. Then you'll see them coming down the water. They stay real close to the hill (shore). Ten or 15 will be jumping at a time. That lets you know you got a good bunch of fish coming to you. The water will be solid black and it could be as many as 10,000 pounds."

Last year Faircloth hit a big school. With about 3,000 pounds in the net and no one to hold up the cork line, the jumping mullet lived up to their name. Faircloth estimates about a thousand pounds of fish leaped over the line.

The ones that stay in the net are reward enough for Faircloth. "I enjoy my mullet fishing," he says. "And I've caught a many a thousand pounds. I really enjoy seeing them come down the water and putting a net around them."

Chances are mullet fishermen like Faircloth, Frost and Smith will continue to fish for mullet even though there's no great demand for it at the

fish market. Well, there's no great demand unless you're talking to a native. "There are hordes of people who can't wait for fall because they love the taste of mullet," says Spitsbergen.

The fishermen scoff at those who say mullet has a "fishy" flavor. How else should it taste, they say.

Natives eat their mullet fried or barbecued over charcoal. And they eagerly await the full moon in October when the largest roe mullet are said to be found. They like their roe fried, baked, salted or scrambled in with their eggs. Smith says some folks like mullet roe so much that they'll keep salted roe in their pocket all day for an occasional nibble.

Spitsbergen says coastal residents keep one secret about mullet well-guarded. There's nothing they like better than mullet pluck, she says. Pluck? It's the gizzard and liver from the fish, of course. "Some people say you have to have a bite of fish and alternate with a bite of pluck to know pure heaven," she says.

For more information on cooking mullet and roe, contact Sea Grant's seafood specialist Sam Thomas or Sea Grant's seafood agent Joyce Taylor at the NCSU Seafood Laboratory in Morehead City at 919/726-7341.

—Nancy Davis

*Photo by Suzanne R. Hill*



*Netting a run of mullet near Atlantic Beach*



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities — on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454). For copies of publications, write UNC Sea Grant, NCSU, Box 8605, Raleigh, N.C. 27695-8605.*



At seafood restaurants, few people stop to think of what it takes to get fresh fish on their platters. From the hook to the cook, there are many steps involved, and all of them are important.

Gary Van Housen, UNC Sea Grant's new regional marine specialist in Bogue Banks, will be working to ensure product quality from North Carolina's fisheries. He'll be advising fishermen, processors, restaurant owners and others, of ways to improve their handling of fresh fish. Van Housen will also develop marketing strategies for various fish found off North Carolina's coast.

Van Housen comes to Sea Grant from the National Marine Fisheries Service in New York, where he was a fisheries product inspector. As inspector, he administered a seafood quality program under the NMFS Grade A certification program and examined seafood for export.

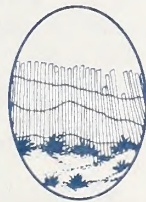
He holds a bachelor's degree in biology from Houghton College in Houghton College, N.Y., and did his graduate work in fisheries biology at the Virginia Institute of Marine Science in Gloucester Point. As a student, Van Housen received two academic scholarships and a Sea Grant award for his master's thesis research.

Van Housen says he sees his work with Sea Grant as a challenge because "North Carolina is a transition zone. You have the northern and southern

fisheries during different times of the year." For example, in the winter, northern species such as sea trout and flounder are plentiful, and in the summer, fishermen find southern species such as pompano and king mackerel.

Also, the state "has a huge estuarine system. This is one of the most productive ecosystems. This equates to more seafood and more seafood products."

For more information about seafood marketing, contact Van Housen at the N.C. Marine Resources Center on Bogue Banks, P.O. Box 896, Atlantic Beach, N.C. 28512. Or call 919-247-4007.



Hurricane Diana is history. But the damage she left behind is still causing headaches for southeastern coastal residents. Spencer Rogers, UNC Sea Grant's coastal engineering specialist at Ft. Fisher, is surveying the damage to see how property owners can prevent problems the next time a hurricane blows North Carolina's way.

"New construction and general construction practices fared very well," Rogers says. "The most common cause of major structural damage was the failure of a porch roof or overhang. When the porch roof blew off it often damaged the main roof and allowed water inside the building."

Rogers estimates that while many structural repairs were not costly, the accompanying water damage often increased financial losses considerably. Rogers says that future damage may be prevented by carefully connecting the porch posts supports to the roof and the foundation.

Despite damage estimates of more than \$70 million, Rogers says Diana was a relatively mild hurricane. The storm surge, a wall of water driven onshore by a hurricane, was minimal, and the hurricane's highest winds were directed offshore. These factors combined to reduce damage to buildings, homes, beaches and dunes.

But he cautions, coastal residents may not be so lucky next time. That's why Rogers is offering technical assistance in storm-resistant construction methods to builders, designers and homeowners making repairs or planning new construction. For help, call Rogers at 919/458-5780.

UNC Sea Grant is seeking accurate wind speed reports recorded during Hurricane Diana at shoreline areas in New Hanover and Brunswick counties. Spencer Rogers will use the information to gauge how well coastal homes and buildings stood up to Diana's fury.

If you watched or had wind speed equipment that recorded velocities during Diana's peak winds, please contact Rogers at 458-5780.



Lights. Camera. Action. The set isn't in Hollywood and stars aren't Richard Gere or Sally Field. Instead, this film's topic is aquaculture, and its stars are fish farmers in Japan, Europe and the United States.

Jim Larison, the director of communications for the Oregon State University Sea Grant Program, filmed and produced the 56-minute documentary, "Farmers of the Sea."

The film traces aquaculture's beginning, examines its more recent successes in Japan, and looks at its competitive edge over wild fisheries in Europe. The documentary questions the future of aquaculture in the United States and shows its potential for helping the people of developing nations feed themselves. Some of the aquaculture research sponsored by Sea Grant is featured in the film. For teachers or museums who would like to rent or purchase a 16 mm or video copy of the film, write Sea Grant Communications, AdS 418, Oregon State University, Corvallis, OR 97331.

*Continued on next page*



Jim Bahen, the UNC Sea Grant marine advisory agent at Ft. Fisher, is testing a hypothesis. He thinks that if the webbing of a gill net is dyed dark colors, it may catch more fish than the typical white webbed net. He believes that the darker webbing may blend better with the water and delay the net's detection by fish.

Bahen has dyed half of a 100-yard gill net dark green and the other half dark blue to test his theory. Keep an eye on the Back Page for his results.

Tyre Lanier, a UNC Sea Grant researcher in the NCSU Food Science Department, is the 1984 recipient of the Earl P. McFee Award. Lanier was cited for his work in surimi research and "for excellence in the field of fishery technology."

Surimi, a minced fish product, can be used in restructured seafood products. For the consumer, Lanier's research may mean a fish product high in food value but low in cost.

The award was presented at the 29th Atlantic Fisheries Technological Conference in Wilmington in August.

Wayne Wescott, UNC Sea Grant's marine advisory agent on Roanoke Island, and Frank Thomas, project director for UNC Sea Grant's work at the NCSU Seafood Laboratory in

Morehead City, were two of 11 recipients awarded Outstanding Extension Awards by North Carolina State University.

Wescott was rewarded for his efforts in establishing a more productive and lucrative soft-shell crab industry in coastal North Carolina. And Thomas received his commendation for his contributions toward developing a seafood processing industry in the state.



On the coast, some farmers do their harvesting underwater. They grow clams, oysters and other shellfish for food and profit. Shellfish farming,

or aquaculture, can be productive in North Carolina. But before cultivating your first crop, know the rules governing shellfishing.

North Carolina law requires that anyone using state submerged bottomlands for aquaculture must obtain a lease from the N.C. Division of Marine Fisheries. Other laws protect natural shellfish beds, public trust rights and riparian rights and prohibit use of polluted waters.

For more information on shellfish aquaculture laws, write UNC Sea Grant for a new publication, *Shellfishing, North Carolina's*

*Aquaculture Regulations*. Written by Walter Clark, Sea Grant's coastal law specialist, the book explains shellfishing regulations and provides checklists for lease, license and permit requirements for harvesting different species of shellfish.

To receive a copy of this booklet, ask for publication UNC-SG-84-06. The cost is \$1.

Joye Stephenson will replace Elaine Murray as UNC Sea Grant Director B.J. Copeland's administrative secretary. Murray left after six years at Sea Grant to join a new firm in Apex. Stephenson comes from the NCSU Civil Engineering Department. She's been with the university for 11 years.

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# COAST WATCH

JAN 7 1985

Photo by Spencer Rogers



At Masonboro Boat Yard, floating homes (background) dock alongside pleasure boats

## Floating homes

The ceiling fan whirled as R. Ryerson Bennett stretched out on the sofa in front of the open glass door. His wife sat down beside him to watch the birds and to relish the cool breeze passing through the room. To the Bennetts, there's nothing quite like living in a floating home. The free-spirited, barefooted kind of lifestyle suits them just fine.

After sailing along the East Coast for 16 years, the Bennetts finally put their anchor down in Wilmington's Masonboro Boat Yard two years ago. They sold their boat and built the home that is now 260 square feet of contentment for them.

Floating homes, complete houses resting on a hull, are not a new idea. The Japanese and Chinese have been living on them for years. In the United States, their popularity is growing, especially in Washington and New Jersey. Only about 30 such vessels are moored in North Carolina's waters. Seven of them are

*Continued on next page*



floating at the Masonboro landing among sailboats and motorboats.

Living in a floating home is comparable to its conventional counterpart, but most residents say it's even better. They have electricity, running water, televisions and telephones. And there is air conditioning and heating. As a matter of fact, Andy Canoutas says he doesn't miss anything after seven years on the

water—not even a yard. “I got so tired of cutting grass,” says Canoutas, an attorney in Wilmington. That was one of the reasons he built his floating home in the first place, but there were others.

“I love the water,” he says. And, “the people here are very unique.”

Andy Canoutas

About 40 people live at the boat yard year-round, says office manager Steve Lee. The resulting community is a hodgepodge of professionals, retired people, natives, world travelers, singles, couples and more. Everyone is different, yet there's something that binds them all together.

“Everybody's interested in the same thing,” says Bob Pierce, an 80-year-old Pittsburgh, Pa., native who moved to Wilmington four years ago. It's the water, boats and nature that draw them to the docks.

“It's like a constant nature show,” says Suzan Perry-Canoutas. “It's so peaceful out here.”

Being able to look out the window and see changing scenery, sunrises, sunsets and exotic birds is what she enjoys most about living on the water. It's not unusual for her to see dolphins playing, pelicans diving or fish jumping in the water. A few years ago, some otters came to live on her back porch. And when the season's right, she and her husband go shrimping, crabbing or shellfishing in surrounding waters.

Kitchen-window viewing goes beyond normal bird watching at the Bennetts', too.

“One day we had an octopus hanging on the side of the boat,” recalls Ryerson. “It would move on the side of the boat as it ate the barnacles.” He and his wife, Mary Jo, watched the 10-foot creature for hours as it inched down the boat.

Because they live on the water, most of the boat yard's permanent residents say they are more conscious of the weather and seasons. They can sense the season's change by noting wind directions, moon positions, differences in water color and the types of birds flocking around the boat yard.

Bonds such as these add to the community spirit at the boat yard.

“Everybody is real close,” says Suzan. It's like a big family. And to them, any time is a good time to get together.

Twice a month, the family meets for community dinners. Then there are parties when people leave the marina, when they come back, for good weather, birthdays and any other “excuse” they can think of. Once the boat yard even held a birthday party for the 17-year-old cat of one of the residents. Of course, all the other cats and dogs from the marina were invited.

Halloween and Thanksgiving are two annual celebrations you wouldn't want to miss, says Ryerson. Crazy costumes are a trademark of the Halloween parties. And at Thanksgiving, the food and fellowship come in generous proportions.

Probably the most special time of year at the boat yard, however, is Christmas. Each

year, boat owners have a party and decorate a tree on the waterway with “personalized ornaments” that say something about themselves. When the tree is finally lit, “You can see it beautifully from the waterway,” says Ryerson.

If you're thinking that Masonboro Boat Yard is the Shangri-La of the South, there are a few disadvantages to living on a floating home.

One is that it might blow away. During Hurricane Diana, the homes were either tied to the dock or moved back from the open water. Most of them survived the storm with little damage. The heavy rains soaked Andy and Suzan's ceiling, while the winds knocked away their steps, a few of Bob Pierce's windows and 24 of the Bennetts' tomatoes.

Rough water can be a problem at other times of the year, too. Although he doesn't have much trouble with pictures and plants falling from the wall, Andy says it's hard to get his balance upstairs or in the downstairs shower when the house is swaying.

Mildew and cold walks down the dock in the winter were two other annoyances residents mentioned. And then there's the matter of putting things away.

“Storage is a tremendous problem,” says Mary Jo. Ryerson is constantly putting up new shelves,

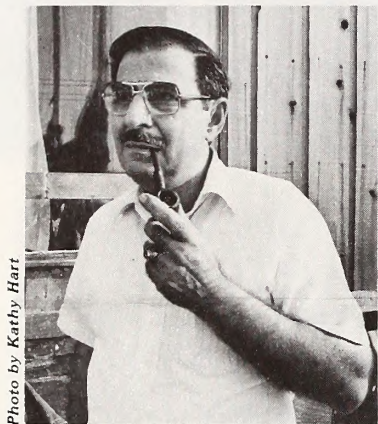


Photo by Kathy Hart

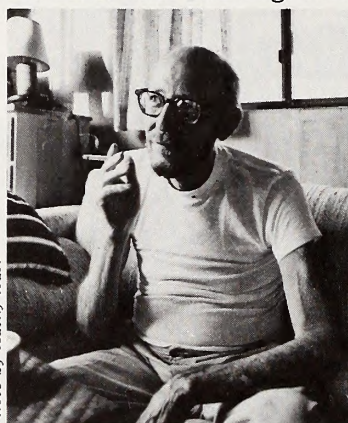


Photo by Kathy Hart

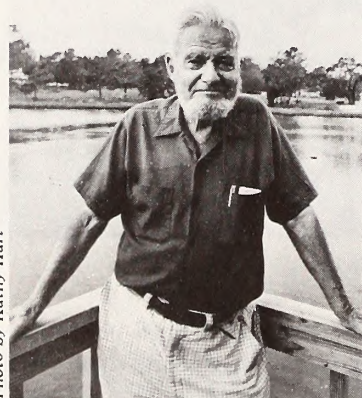


Photo by Kathy Hart

Bob Pierce



bookcases or hanging baskets for her to use as stowage.

The situation is similar at Andy and Suzan's. Even with 800 square feet of space, it seems they always need more. The closets are packed, and things are tucked here and there all over the house.

Residents never hesitate to tell visitors one other thing about the boat yard—it has a monster. The illusive Masonboro Monster lurks underneath the boats that moor there, grasps onto them and never lets them go. Sailors come intending to stay only a night or two and end up docking for years. People take trips and come back, and others come back seasonally.

Bob Pierce was one of those who became permanently entangled in the tentacles of the monster. He first came to the boat yard in 1972 when he and his wife were sailing the coast. They liked the place so much that every time they traveled by it they would stop and stay awhile. When Pierce and his wife stopped sailing, the tides carried them back to Masonboro, where they built their floating home.

"We had been cruising, and we'd been on the water for 14 or 15 years," Pierce says. "We liked being on the water. We liked waterfront property, but we

Photo by Kathy Hart



Mary Jo Bennett

didn't like to rake leaves or mow the lawn."

Like Pierce, "People just keep coming back," says Mary Jo. "Yes, that's the charm of the yard."

—Sarah Friday

## New wave in housing

# Regulating life on the water

Most people prefer to live on dry land. But others like a wetter environment. They'll choose a house that rolls with the swells over one on solid ground any day.

More people are moving into floating homes as a way to obtain low-cost waterfront housing. But the increase is causing some headaches for state and local governments as they struggle to regulate waterborne housing.

At the base of the struggle lie three main questions: what is a floating home, who has the authority to regulate it, and why does it need regulation?

Take the first question. What is the difference between a floating home, a houseboat and a boat? The answer depends on who is doing the defining.

According to the N.C. Coastal Resources Commission, a boat is a self-propelled vessel that is used to travel from place to place by water.

Sailboats, power boats and what most people consider as houseboats—self-propelled trailer-like structures attached to a hull—fall into this category.

On the other hand, a floating home, called a "floating structure" by the CRC, is a vessel that has no means of operative propulsion, is inhabited or used commercially in one place for more than 30 days, and contains more than 200 square feet of living space. For the most part, a floating home looks like a house built on a barge.

New Hanover County, the only county in North Carolina to regulate floating homes (see story, page 5), considers a floating structure any "primarily immobile" vessel or structure used as a permanent residence, business or club site. It makes no difference whether the vessel or structure has a means of propulsion.

The definitions for floating homes also vary from state to state. In Seattle, Wash., a floating home is a building constructed on a float, which is used partially or entirely as a single-family dwelling.

Federally, no distinction exists between floating homes and boats. Anything that floats is considered a vessel.

Why all the definitions? Governments need to define floating homes to regulate them. States such as California, Washington and New Jersey were faced with growing numbers of floating homes using their waters as a full-time residence and no means to govern them. Land-based laws didn't apply. And federal maritime laws didn't tackle pertinent local concerns—density, zoning, water quality and provision of land-based services (trash collection, sewer and water service, police and fire protection).

*Continued on next page*



In North Carolina, a company began to manufacture and market floating homes as alternative housing along the Southeast coast. The prospect of large communities of floating homes prompted New Hanover County officials to ask the CRC, which manages coastal development, to draw up regulations.

**B**ut before policies could be made, we had to decide who had the authority to do what," says Dave Owens, director of the Office of Coastal Management. "For example, should a floating home's sewage disposal be regulated by Coastal Management, the county sanitarian, the state Division of Health Services, DEM (the Division of Environmental Management) or the Coast Guard? There were some definitional and jurisdictional questions that had to be decided."

And some problems imposed by floating homes needed to be addressed, Owens says. Officials were concerned about water quality impacts, infringements upon public trust waters (state

waters owned collectively by every citizen) and local problems with zoning and the provision of city or county services.

Water quality headed the list as the top concern. Since floating homes are considered vessels by the federal government, they must comply with U.S. Coast Guard regulations that require all vessels operating within three miles of shore to be equipped with marine sanitation devices or onboard holding tanks.

A marine sanitation device treats and grinds sewage before discharging it into the water. A holding tank stores the sewage until it can be emptied or pumped out onshore. Neither method treats or holds shower or galley effluent, called gray water, which is usually discharged directly overboard.

But state and local officials said the Coast Guard regulations were not enough. In large congregations of floating homes, treated effluent and gray water could add up to water quality problems. "Marine sanitation devices were not designed or equipped

to handle waste disposal on a permanent basis," Owens says.

And then there's the matter of public trust rights. Every North Carolina citizen has a stake in the state waters, which they have a right to use, says Walter Clark, UNC Sea Grant's coastal law specialist. But do they have a right to occupy the water permanently, excluding others from its use?

The CRC held public meetings along the coast to develop a floating structure policy. After much discussion, the commission adopted a policy that became effective July 1, 1983. The policy establishes a definitional distinction between floating structures and boats and restricts the use of floating structures to permitted marinas, banning them from public trust waters.

**T**he policy also prohibits floating structures from discharging sewage into state waters, requiring instead, use of the city/county sewage treatment system, an onshore septic tank or any other means allowed by local regulations.



Photo by Spencer Rogers

*Officials are concerned about the effects of floating homes on water quality*



With adoption of the policy, the CRC could exercise some control over development of floating home communities. But there is a catch. The policy does not apply to existing floating homes that have been tied up or will tie up to existing docks at existing marinas, Owens says.

**T**he Office of Coastal Management, the enforcement arm of the CRC, regulates development through a permit system. And a marina only needs a permit if it makes a physical change such as building a dock, excavating or altering onshore facilities. Only then can the OCM ask that floating homes docking at that marina comply with CRC policies.

While some floating structures may slip through the fingers of OCM enforcement, county governments can adopt more inclusive local ordinances. And decisions are made at the county level about zoning and density requirements and the provision of city or county services.

But it falls to the N.C. Department of Administration's State Property Office to decide how state public trust waters can be used and whether the

"Before policies could be made, we had to decide who had the authority to do what."

—Dave Owens

Photo by Steve Wilson



state should be compensated for that use. Presently, the SPO has no policies concerning floating homes. And officials say any SPO decisions concerning floating homes are several studies, definitions and guidelines down the road.

The SPO may have time to ponder the matter because floating home growth hasn't boomed in North Carolina as predicted. Officials warn, however, that the rising cost and

decreased availability of waterfront property will eventually lead more people to buy floating homes.

But there are those who say that state and local governments may have missed the boat altogether. The sailboat, power boat and houseboat, that is. They believe more people live full time on these vessels than live on floating homes. And they pose the same kind of problems.

—Kathy Hart

## The local angle:

# New Hanover sets standards

**N**ew Hanover County Inspections Director S.D. "Sky" Conklin has a philosophy: It's better to respond to a potential problem than to react to one that's already there.

When Conklin heard a floating home construction business was going to locate in New Hanover County, he had visions of a waterfront crowded with floating homes. So far, that vision hasn't been realized. But if the time comes, they'll be ready, says Conklin.

In 1983, at Conklin's urging, New Hanover County became the first in the state to regulate floating homes with a local zoning ordinance. In the process, the county nudged the state into taking action.

Before the county could enact its ordinance, it had to get permission. Traditionally, local governments did not have clear authority to regulate the waters surrounding a county. Spurred by New Hanover County's desire to control development on the water, the N.C. General Assembly gave counties the explicit authority to regulate development on navigable waters within their boundaries.

Ken Silliman, assistant attorney for New Hanover County, says the choices of regulations ranged from an outright ban on floating homes to no regulation at all. Silliman said the county chose an approach somewhere in the middle of those extremes. "We're not going to say we're going to ban them (floating homes) entirely or that you can locate them anywhere. We say that you can only locate in an approved floating home marina."

The county goes even further in its regulations. The ordinance limits the density of homes in the marina. For each floating home, the marina must set aside 2,000 square feet of land and provide a minimum of two parking places to avoid placing too much stress on adjacent land. The county building inspector must approve each floating home before it is docked at the marina. And, the New Hanover County Health Department must approve the permanent water and sewer systems required on each home. (For more specific regulations, please contact New Hanover County offices.)

UNC Sea Grant coastal law specialist Walter Clark says

*Continued on next page*





*Residents must pipe all wastewater ashore*

such local ordinances are an attempt to regulate people who use the water as a place to live as opposed to those who use the water for recreation.

When challenged in court, ordinances regulating floating homes have generally been upheld, says Clark. A New Jersey township went so far as to outlaw floating homes. That ordinance was recently upheld by a U.S. District Court.

Clark thinks other counties may follow New Hanover's lead. With the increased interest in floating homes, local governments are questioning their ability to provide services such as police and fire protection, water and sewer facilities, and garbage collection—all services provided through the monies collected from real property taxes. (Clark is preparing a Blueprint on floating homes to be published early next year.)

New Hanover County Commissioner Karen Gottovi doesn't think taxpayers realize that floating home owners don't pay real property taxes. To some, it sounds like a free ride. But floating home owners claim they indirectly pay property taxes. They pay a rental fee to the marina which, in turn, pays property taxes.

So far, Gottovi says public sentiment is in favor of the ordinance. She predicts New Hanover County won't be alone for long in its regulation of floating homes. "I see a potential problem particularly in the Pamlico and Albemarle and in Morehead. It's a problem people are going to have to face."

In New Hanover County, the brunt of the controversy over floating homes came to bear on Masonboro Boat Yard in Wilmington. Steve Lee, office manager at the marina, says the boat yard received a lot of attention because there were already floating homes at its docks.

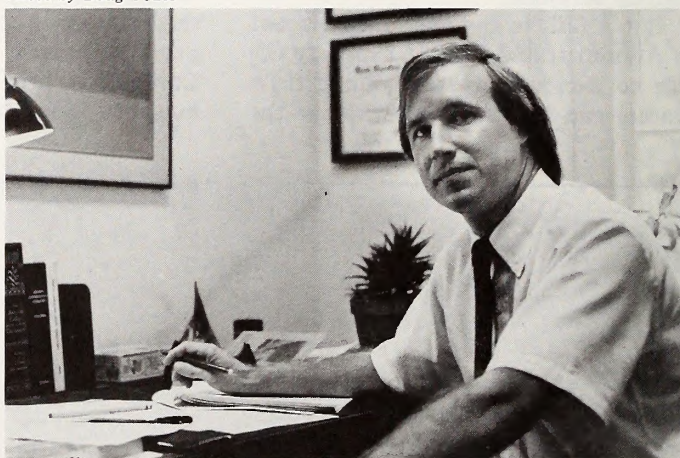
"Because the boat yard did not want to see floating homes prohibited, we worked with the New Hanover County planning board. We talked with them about the practical aspects of siting and sewage disposal. And they came up with an ordinance we could live with and the county could live with," says Lee.

At the time, seven floating homes were docked at the marina. Of those, three were on the boat yard's sewage system, two had no on-board toilet facilities and two had Coast Guard marine sanitation devices.

According to the ordinance, the latter four floating home owners have until April 2, 1985, to comply with the new standards. As of now, there have been no permits issued for floating homes or for floating home marinas. But by the April deadline, all existing floating homes must have made arrangements to pipe all their wastewater ashore.

—Nancy Davis

Photo by Doug Yoder



*Walter Clark*

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, Box 8605, NCSU, Raleigh, N.C. 27695-8605.

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I am in the following line of work:

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|---|--|
| <input type="checkbox"/> Boatbuilding/Repair    | <input type="checkbox"/> Marina operator                 |
| <input type="checkbox"/> City/County government | <input type="checkbox"/> Marine recreation               |
| <input type="checkbox"/> Commercial fishing     | <input type="checkbox"/> Mass media                      |
| <input type="checkbox"/> Educator               | <input type="checkbox"/> Seafood processing/marketing    |
| <input type="checkbox"/> Farming                | <input type="checkbox"/> State government                |
| <input type="checkbox"/> Homemaker              | <input type="checkbox"/> University professor/researcher |
| <input type="checkbox"/> Lawyer                 | <input type="checkbox"/> Other _____                     |

Coastal property owner ☐ yes ☐ no Boat owner ☐ yes ☐ no



# THE BACK PAGE

*"The Back Page" is an update on Sea Grant activities — on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454). For copies of publications, write UNC Sea Grant, NCSU, Box 8605, Raleigh, N.C. 27695-8605.*



Everyday, corrosion silently gnaws at materials and machines exposed to the elements. Not so quietly, however, it gnaws at the pocket-book of the economy.

This year alone, corrosion will cost the United States about \$150 billion.

"It's everywhere you look," says K.L. Money of The LaQue Center for Corrosion Technology, Inc., at Wrightsville Beach. Our cars, bridges, screen doors and even our hammers are affected by it. It's the job of the center to research the forces of corrosion and help find some solutions.

Money says corrosion occurs because "when we form, or make, or shape materials into alloys . . . we've altered the natural state of that material into some form that we can use. In just the laws of nature, those materials have a tendency to want to return to their natural state. Steel wants to return to iron ore, and as a result, it will have a tendency to corrode. The same thing's true with aluminum, copper-based alloy and any of the other alloy systems."

Corrosion is often confused with rust, but there's really no difference between the two, Money says. Rust is the corrosive mechanism of iron-based materials such as iron and steel.

The coastal environment, although not the worst, is highly susceptible to corrosion. "The materials used in and around the marine environment, in sea water and coastal zone areas, are

seriously affected, of course, by the strong, corrosive sodium chloride, which is the main constituent of sea water," Money says.

Boat owners, coastal residents and visitors can take certain steps to retard the deterioration of their property. Boats and cars should be rinsed frequently to wash off the salt. Also, painting or coating alloy products, such as crab pots and screen doors, can help curb corrosion.



When the holidays are over, you can put your Christmas tree to another use—building a dune. Natural Christmas trees can be used to repair dunes worn down by vehicle and pedestrian traffic, says UNC Sea Grant's coastal engineer Spencer Rogers.

The tree's branches trap blowing sand, becoming the skeleton of a new dune. While Rogers says the trees can be used to repair dunes damaged by people and vehicles, they shouldn't be used to repair dunes eroded by wave action.

Each year, Sea Grant and the N.C. Marine Resources Center at Fort Fisher sponsor a dune-repair program. To participate in this year's program, bring your tree, stripped of its ornaments, to the center Jan. 1 at 2:30 p.m.



Since managing fisheries means managing people, it pays to learn something about the people being managed—their traditions, their ambitions and their abilities. That way managers can gauge how possible changes in regulations and policies will affect fishermen.

To school future managers in the ways and impacts of resource management, UNC Sea Grant Director B.J. Copeland has awarded a mini-grant to John Maiolo, chairman of East Carolina University's Department of Sociology, Anthropology and

Economics. Under Maiolo's supervision, two graduate students and one undergraduate student will work with the N.C. Division of Marine Fisheries to survey a sample of the state's shrimp fishermen.

The students will analyze the information gathered and determine how different shrimp closures and season policies will affect fishermen. The Division of Marine Fisheries may use the information to reformulate policies.

Menhaden, shrimp, blue crabs and flounder consistently provide most of the value and weight of the state's commercial catch. But what about croaker, mullet or squid? Is there no economic incentive to catch these species? Or do these species have a low abundance?

Vito Blomo, an economist in the Department of Sociology, Anthropology and Economics at ECU, will attempt to answer some of these questions through a Sea Grant mini-grant. Blomo will analyze the productivity of the state's commercial fisheries to evaluate the feasibility of intensifying existing fisheries or developing new ones.



Just inches below the earth's surface in northeastern North Carolina lie the secrets of another civilization and another time. These soils are rich in the artifacts of the Algonkian Indians, who inhabited the area.

With support from UNC Sea Grant mini-grant funds and the America's Four Hundredth Anniversary Committee, Michael Orbach and Paul Green, two anthropologists in the Department of Sociology, Anthropology and Economics at ECU, are using these artifacts to reconstruct the lifestyle of the Algonkian Indians at the time of their contact with the English.

*Continued on next page*



Orbach and Green are examining stone and bone tools, pottery pieces, arrowheads and food remains from an area along the Chowan River, which they believe to be the Algonkian village Chowanoke. Next year they plan to locate the village of Pomeiooc, which artist John White (governor of the Lost Colony) depicted near Lake Mattamuskeet on one of his maps.



Lise Knelson is one of 14 students from across the country who has been awarded a Sea Grant internship in Washington, D.C., next year. Knelson, the 1983 recipient of the North Carolina Sea Grant Marine Policy Fellowship, will serve with a House or Senate committee in Congress.

Knelson is a zoology graduate from the University of North Carolina in Chapel Hill and a graduate student at East Carolina University in sociology. Her graduate work emphasizes marine policy.

Sea Grant Director B.J. Copeland and Bill Queen, coordinator of Sea Grant's estuarine studies, are the principal investigators in a project for the National Oceanic and Atmospheric Administration's Sanctuaries Program Division. Copeland and Queen will be

developing priorities for research in the nation's estuarine sanctuaries.

The investigators will assemble a team of the nation's outstanding estuarine researchers to help them devise approaches for relating management issues to research requirements. Among the goals of the project is to encourage the use of estuarine sanctuaries for research sites.



In 1983, nearly 60,000 pairs of waterbirds nested along North Carolina's coast. Over 75 percent of those birds made their homes on man-made dredge-spoil islands. But the number of sites suitable for the birds is declining while the size of the colonies is increasing. With such large concentrations of birds in a small number of sites, biologists fear a single catastrophic event, such as an epidemic, could mean disaster for a large percentage of birds.

Using Sea Grant mini-grant funds, James Parnell, an ornithologist at the University of North Carolina at Wilmington, will develop a comprehensive management plan for the colonial waterbirds in the state's coastal zone. Parnell will outline the management needs of each species and identify techniques for population monitoring and for maintaining appropriate habitats for each species.

North Carolina's seafood industry cooked up some good business in Raleigh Oct. 30 and 31. That's when Gary Van Housen, UNC Sea Grant's regional marine specialist, participated in Foodservice Frontiers '84, an expo for the institutional food service market.

For the two-day event, Van Housen exhibited seafood and handed out pamphlets, recipes and advice on using North Carolina's fish products. While onlookers gazed at fresh snapper, scallops, oysters and a live soft shell crab, Van Housen answered their questions about seafood and the Sea Grant Program.

He said he hoped to promote seafood among the institutional buyers at the expo, and to help people learn more about seafood.

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